PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

167-177 TIMES BUILDING, NEW YORK.

Established 1874. Incorporated 1889.

W. J. JOHNSTON, Prest. C. E. STUMP, Treas. and Bus. M'g'r.

Telephone Call: Nassau 924 Cable Address: "Electrical," New York.

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New England Office, 8 Cook Building, Boston.
Western Office, 39 Mallers Building, Chicago.
Philadelphia Office, 31 City Trust Building.

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.

(Including Postage in the U. S., Canada or Mexico.)

IN CLUBS of four or more, $2.50 a year each; with a free extra copy to the getter up of a club of 8. Foreign subscription, $5 a year.

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THE W. J. JOHNSTON COMPANY, Ltd.,
Times Building, New York
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VOL. XV. NEW YORK, FEB. 1, 1890. No. 5.

CONTENTS.

ILLUSTRATED ARTICLES: PAGE.

ELECTRICAL WORLD Portraits, XI. Prof. W. A. Anthony..... 70
Glimpses of the Recent St. Louis Electrical Exposition..... 71
Coffin's Method of Electric Welding 72
"The Genius of Light" Statue..... 72
A Novel Electric Water Level Indicator..... 72
Seely's Electric Connector..... 73
The El Paso Company's Station, Colorado Springs, Col..... 73
The Young Automatic Safety Cut-Out..... 73
Dewey's Series Electric Railway System..... 74
The Electric Motor, and Its Relation to Electric Lighting Companies, By W. H. Fitzgerald..... 74
A Novel Lag Screw Wrench 75
Dean Brothers' Duplex Steam Pumps..... 75
The Morris Insulated Suspension Pulley..... 75
Special "Ideal" Engines for Electric Lighting and Power..... 76
The Hercules Mining Machine and Tesla Motor..... 77
The Jenkins Combination Electric Motor and Drill..... 77
Electric Locomotive for Metal Mines..... 77
A Review of Modern Electrical Theories. By Prof. W. A. Anthony..... 78

CORRESPONDENCE:

Leclanché Cells on Closed Circuit. Geo. Sweisfort..... 72
Duplex Telephony. A. M. Rosebrugh..... 76
The Converter Tests at the Massachusetts Institute of Technology. Prof. C. R. Cross..... 76
Brightening of Incandescent Lamps on Switching Off. W. S. Hays..... 77
Power of Water Wheels. F. H. Williams..... 77

EDITORIAL:

Paragraphs..... 69

MISCELLANEOUS:

Equitable Motor Charges. By Emile Kahn..... 70
Notes on Artistic Incandescent Lighting. By F. H. Soden..... 70
The Photo-Engraver's Assistant..... 72
The Illinois Electric Lighting Association..... 73
The New Term, "Ward"..... 76
An Electrical Apparatus for Determining Melting Points..... 76
The Michigan Electric Light Association..... 77
The Electrolysis of Cryolite 77
A Practical Storage Battery. By J. K. Pumpelly..... 79
An Electrical View of the Chicago Auditorium. By F de L..... 79
Tempered Copper for Electrical Work. By G. H. Bliss..... 80
Electric Lighting in the Convention City..... 80
Cornell University Items..... 81
Lieutenant Fiske on Electricity in Warfare..... 81
The Edinburgh Exhibition..... 81
Hazard from Outside Electric Currents..... 81
A Complimentary Dinner to Mr. E. H. Johnson..... 81
Exhibitors at the Kansas City Convention..... 82
The Edison General Electric Company..... 82
The Mutual Electric Insurance Company..... 82
Obituary—Austin Goodyear Day 82

SPECIAL CORRESPONDENCE:

New York Notes, 82; New England Notes, 82; Western Notes, 83; English Notes..... 86

DEPARTMENTS:

The Telegraph, 86; The Telephone, 86; The Electric Light, 86; Applications of Power, 87; Personals, 87; Miscellaneous Notes, 87; Business Notices..... 87
Our Illustrated Record of Electrical Patents..... 87, 88

The Western Field. THE approaching convention of the National Electric Light Association at Kansas City calls attention to the field there for electrical development, and we have therefore devoted a large portion of this issue to Western work, with the object of showing what the opportunities are and how some of them are being realized. Supplementing the illustrated articles and the regular and special Western correspondence, are several important articles by well-known Western experts and electricians on leading topics of the day.

Electrical Theories. THE lively interest now taken by all in the theory of electricity with the new light which recent experiments have shed upon it makes the paper read by Prof. Anthony, before the American Institute of Electrical Engineers, a very timely one. The discussion of E. M. F. and potential will go far toward fixing the difference between the two in the minds of the student. The nature of our future illumination is also touched upon, and some of the ways in which it might be accomplished are hinted at.

Electric Power Distribution. TWO Western contributors to our columns this week take up the question of the distribution of power from electric light stations, and while one confines himself merely to the financial side of the question the other enters in addition into the discussion of the methods to adopt, mechanically and electically, to obtain the best results. As regards the latter, Mr. Fitzgerald shows how the earnings can be increased by a day load current feeding motors, and what profits can be depended on with tolerable safety. On the subject of the type of motor to employ, Mr. Fitzgerald appears to have a strong prejudice, backed up, we must admit, by some weighty reasons, against the series system as compared with the parallel. Though much of what Mr. Fitzgerald says is true, it must not be forgotten that until quite recently very few stations were equipped with both arc and incandescent machines, the former being by far the majority. Hence it became a question of the station manager adapting himself to circumstances and putting in the only type of machine available. But the mechanical drawbacks pointed out as possessed by the series motor as a class, and the system generally, independent of its economy, certainly seem to us to be capable of remedy, and if these faults exist still, they afford a good field for our inventors. Mr. Fitzgerald's article is an able and timely production.

The Alternating Series Railway. NOTWITHSTANDING the acknowledged success of the almost universal parallel system upon which electric railways are operated to-day, the series system still seems to possess a charm for inventors, and to call forth new ideas from time to time. Evidently the severing of the circuit, necessitated by such systems, introduces complications which it would be well to avoid; and to leave the conductor intact and continuous would be a decided advance in one direction at least. An ingenious method for accomplishing this is that described on another page, due to Mr. M. W. Dewey. The surrounding of the conductor carrying an alternating current by a mass of iron evidently increases the self-induction of the circuit enormously at that point, and creates a counter E. M. F. or artificial resistance, which diverts the current into the motor on the car. But ingenious as the idea is, the question naturally arises as to the extent to which the principle could be practically applied. Without going deeply into figures, it would seem probable that a considerable length of the conductor would have to be surrounded by the iron in order to effect the operation of a motor sufficient to drive a railway car. It would be interesting to know how far the inventor has gone in the application of this method. The principle here involved is evidently applicable to a variety of other purposes, which will readily suggest themselves to the reader.

Edison as a Thinker. WE are so accustomed to look upon Mr. Edison as one whose mind is constantly engrossed in some specific work that it is refreshing to be allowed a glimpse of his more spiritual nature, as brought out by George Parsons Lathrop's "Talks with Edison" in the February *Harper's Magazine*. As a thinker Mr. Edison is no doubt truthfully pictured as one who can instantly transfer the full power of his creative mind from one subject to another without losing anything by the sudden change; and can, indeed, almost follow out simultaneously the threads of thought on a number of subjects. Mr. Edison makes a sharp distinction between discovery and invention, we are told, and it is as an inventor that he prefers to be known; that is, as one who sets about deliberately to accomplish a certain object, as distinguished from one who discovers, perhaps by accident, what has long been sought for. Very few of his inventions, says Mr. Edison, and those of the least importance, were the result of accident, and most of them were hammered out after long and patient labor, and no doubt often stimulated by the encroachment of rivals. The perfected incandescent lamp, which Mr. Edison considers his most important invention, has been the result entirely of deductive reasoning, in connection with which he has set up no less than three thousand theories to explain the phenomena observed. But in only two cases have experiments proved the truth of the theories assumed. Our readers may also be interested to know that Mr. Edison is a believer in an intelligent Creator.

Mutual Insurance. IT is but a few days since that we listened to the complaints of a manufacturer, whose rate of insurance had nearly been trebled on account of the proximity of an electric light station to his works, and who proposed to seek relief by moving his factory to the country, notwithstanding the fact that he owned the building in which he was located. This was but another result of the baseless panic which seems to have taken hold of the stock insurance companies with respect to electric light stations, and which, we had reason to believe, had died out some time ago. Its existence, however, makes the starting of an electric mutual insurance company eminently timely, and the work of such a company, as foreshadowed in its prospectus, if faithfully carried out, cannot fail to result in a marked benefit to the electric lighting industry in this country. The immediate effect of such a company will be a decided improvement in the character of the central stations to be constructed in the future, while the bettering of the condition of the majority of those existing at present must follow as a matter of course. But besides the actual low insurance afforded, the periodical visits to the stations by a competent inspector who has the opportunity of observing the best practice everywhere will give each company the benefit of the other's work, and thus prove a source of actual profit to every individual. With Messrs. Barton and Brophy as the promoters of the new Electric Mutual Insurance Company, it is not to be wondered at that it has the support of all the electric light companies, and we shall do all in our power to support so worthy an enterprise. The company may count on our hearty sympathy, co-operation and encouragement in so laudable and desirable a movement.

Alternating Current Phenomena. IT is often the case that the experiments of the investigator in any given department lead him to the discovery of other allied phenomena, the application of which may add considerably to the value of the work in hand. We are led to this reflection in contemplating the phenomenon claimed to have been discovered by Mr. C. L. Coffin, and described elsewhere, in virtue of which the heat at a joint to be welded electrically is increased by the proximity of a magnet. Two different causes, it would seem, might be assigned to account for the phenomenon. Remembering the action of the magnet on the electric arc and its power of diverting the path of the electric current, it might be assumed that by bringing the magnet close to the joint, the path of the current is deflected, and the length of conductor through which it passes is increased. This would be tantamount to increasing the resistance of the material at that point, and hence the increased heat due to that higher resistance. But it seems probable that the results obtained may be ascribed to another effect, which has been utilized in another way and employed in connection with the novel alternating current series railway system of Mr. M. W. Dewey, also shown in this issue. We may suppose that the proximity of the iron at the welding point creates a high self-induction and counter E. M. F. at that point, and hence acts in the same way as a resistance would to increase the heat. Of course, the latter case presumes the application of the alternating current in the welding operation. Unfortunately, we are not informed whether Mr. Dewey uses the alternating or the continuous current. If the latter be used, then the first explanation given could alone be deemed as applicable to the case. The phenomenon is certainly an interesting one, and will bear further investigation.

A Blind Leader of the Blind. WELL nigh seventy years ago Byron wrote: "This is the patent age of new inventions, For killing bodies and for saving souls;" but he was wrong, if we are to accept the views expressed by Mr. George William Curtis in *Harper's Magazine* for February. According to that mentor of the Easy Chair, the age in question began with the introduction of the electric light, that being the great evil which we moderns have to dread. Says Mr. Curtis: "How many a hapless victim has been put to sudden death by the wretched wires in the streets of New York alone!" Well, there have been some victims, and there have been wretched wires, but, all told, there are fewer deaths on record from electricity in New York since its introduction as an agency of light and power than there are from vehicles in the streets in a single year. But Mr. Curtis goes on: "The Boston fire was caused by these uncomprehended agents, and it is shrewdly suspected that the Brooklyn Tabernacle was kindled by them and not, as wildly suggested, by the fervor of the pastor's eloquence." As to the Boston fire, there is no evidence to prove, and never will be now, that electricity caused that fire. It might just as well have been caused by half a dozen other things. As to the Brooklyn Tabernacle, there is positive evidence proving that electricity had nothing to do with it. We need only mention the indisputable fact that the electric light switchboard in the church was among the few things untouched by the fire. Mr. Curtis is one from whom the public has a right to expect a strict adherence to known and settled facts, not a haphazard reference to what is "shrewdly suspected." His facts about which "there is no manner of doubt whatever" are very much like those of the Grand Inquisitor in Gilbert & Sullivan's new comic opera—they are all doubt and no fact. Mr. Curtis then tells us what "the truth" is. "The truth is that the electric light is an untamed afreet. Its laws are apparently ill understood. The courteous host who shows you through his noble mansion, *illuminato al giorno*, is evidently a little afraid of his nimble servitor. Candles and gas and the lamp of sperm or kerosene are familiar in the strictest sense. He anticipates no ill turn from them save the malodorous consequence of neglect properly to shut off the gas." Evidently Mr. Curtis has never read of a death or a fire from oil, candle or gas, and is so little acquainted with electrical science and application that he supposes the whole vast growth and development of the last ten years to have been effected by ignorant practitioners among nervous patrons. We have a right to expect a better appreciation of the case than this from one so distinguished as an amiable and trustworthy philosopher, and can hardly forgive him. As an apostle of sweetness and light, he should be among the first to advocate the cause of electricity, for if that be not the noblest source of sweetness and light, we know not what is.

ELECTRICAL WORLD PORTRAITS.—XI.

PROF. W. A. ANTHONY.

The subject of the present sketch was born November 17, 1835, at Coventry, Rhode Island. He attended the village school, where, having an unusually good teacher, he was enabled to begin at an early age the study of algebra and geometry. He also read all the books on science to be found in the school library, and obtained considerable experience with machinery and tools in his father's mill. At the age of 15 he went to the Friends' Boarding School in Providence, where he pursued his favorite studies in mathematics and science, and for a time assisted in the preparation of experiments for the lectures on chemistry and physics. Completing his preparations for college at the academy at East Greenwich, he entered Brown University in 1854, but under the compulsion of his deepening interest in mathematical and scientific studies he left Brown to enter the Scientific School at Yale, where he graduated in 1856.

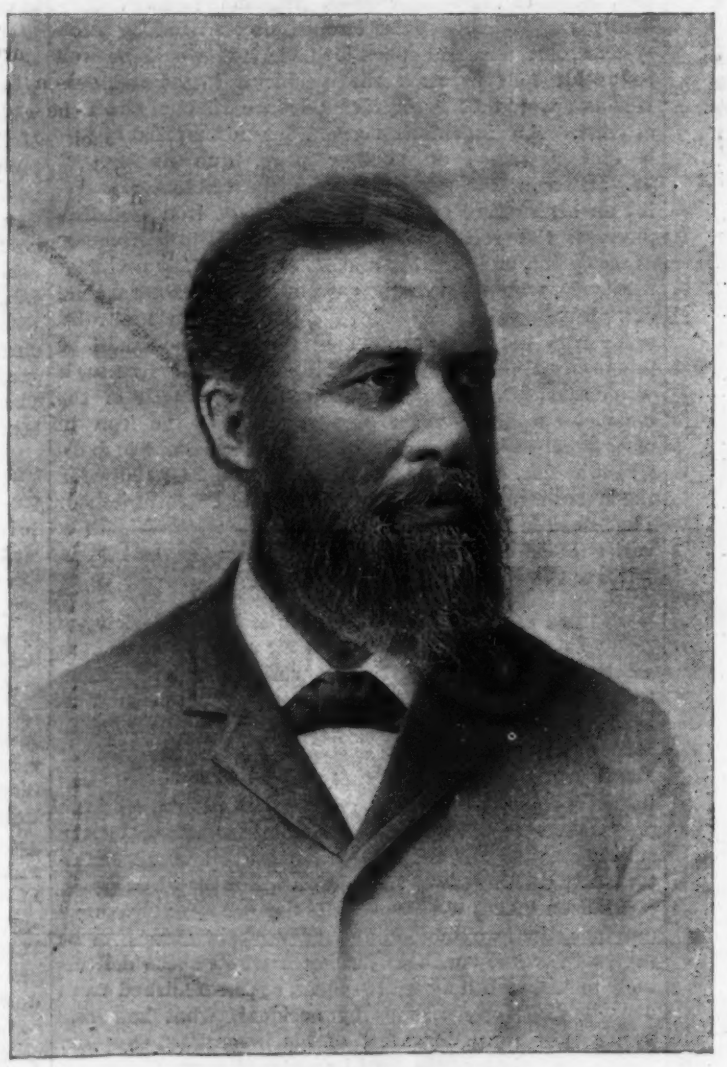
The ability to give instruction had by this time manifested itself very clearly, and after graduating, Prof. Anthony became the principal of a graded school. He then taught science in an academy, then physics and chemistry at Antioch College, and then physics at the Iowa State Agricultural College. But there was a crying need for the services of such a man in the East, and thus in 1872 he was called to Cornell University to take charge of the Department of Physics. He remained there till 1887, and it is no exaggeration to say that he left behind him an imprint that the work of Cornell in his special field will long bear. His interest was specially strong in electricity and optics, and he devised a great number of experiments to illustrate his instruction. Even in the academy, in 1863-66, his students in physics were required to perform experiments for themselves. This was the beginning of his physical laboratory instruction, which he tried to improve upon and extend as long as he had to do with students and to prepare for their careers the physicists and engineers of the next generation.

It is interesting to note that in 1874, after trying in vain to procure a Gramme machine from Europe, as a piece of laboratory apparatus, he designed and constructed one for the university laboratory himself. This machine was exhibited at the Philadelphia Centennial Exhibition in 1876. It is still in use and doing good service in the physical laboratory at Cornell.

In 1881, appreciating with clear foresight the important place that electrical applications were to take in the near future, Professor Anthony set on foot a movement looking to the establishment at Cornell of a special course of study for the training of electrical engineers. This plan met with great opposition at first, but was finally successful, and the course is now one of the best attended in the university. Every reader of this journal is familiar with the excellent quality of the men turned out as electrical graduates, and with the high character of the original investigations pursued in the electrical department.

In 1887, desiring relief in a change of occupation, Prof. Anthony resigned the appointment he had held with so much credit to himself and so much honor to Cornell, and assumed the duties of electrician for the Mather Electric Company, of Manchester, Conn., in which capacity he has since continued, devoting himself to the improvement of the apparatus and the extension of the affairs of the company. During this last period, he has brought out some interesting and valuable measuring instruments, including the coils, bridges, etc., that have from time to time been illustrated in these columns. The patents issued to him also show his inventive ability and range of investigation to embrace a number of the newer lines of pioneer electrical development.

In another part of this issue will be found the suggestive paper read by Prof. Anthony last week, before the American Institute of Electrical Engineers, of which he has long been a valued member and officer, dealing with the modern theories of electricity. The reception accorded the paper by the large and representative audience could not but be gratifying to one who for so many years has stood as the exponent of the soundest and best thought in this sphere of speculative inquiry and patient research.



PROF. W. A. ANTHONY.

Equitable Motor Charges.

BY EMILE KAHN.

It is now conceded that for the transmission and distribution of power, electricity as a medium possesses singular advantages over any other natural agent. All kinds of manufactures and trades are alive to simple and economical means of transmitting power, and it is clearly to the interest of light and power companies to promote, foster and develop the use of motors whereby they are enabled to utilize their plants sixteen hours per day instead of six. One of the important factors, however, is the question of economy in the use of electricity, and the first question propounded by a manufacturer is: How much will it cost? or, How much can I save by substituting electrical for steam, hydraulic or pneumatic power? Certainly no complaint can be made against the present charges for constant use for ten hours per day for motors. These charges had for their origin and basis the driving of ventilating fans in restaurants, etc., to which use motors were first generally applied. These, of course, during the season in which they are employed consume a constant amount of electrical energy for a constant time, and hence the charge of a given sum for a given size motor per month was and is equitable. At the present time, however, so rapid has been the advance in general adoption, that the use of motors for this purpose is of minor importance, both as to the sizes employed and short season of use.

Within the last two years electric motors have been applied to not less than 135 different kinds of industries, in some instances superseding steam and gas engines and water motors. In most of these industries these motors are in daily use, but with varying duration and power. As these latter industries call for power twelve months in the year, instead of three, as in the case of the fans referred to, it would seem that a new basis of charges, accommodated to the new order of things, should be made. This statement is not made from a sentimental standpoint, or even from an abstract sense of justice, but represents the daily experience and practical observation in the introduction of motors, and it involves, to a very large extent, the future life of the electric power business.

It is a marked characteristic of human nature to have a disinclination to pay for service not fully rendered. Every man wants value received and the idea of paying for two horse power when he uses only one, or being charged with 10 hours a day when only three are consumed, even though the cost be the same, excites a feeling of antagonism not conducive to the adoption of electric motors.

The printer, for instance, who uses a gas machine pays for the amount of power only that he actually uses for the time that his machine is in use, and he is enabled to practice economy by regulating the quantity and time according to the demands of his business. Suppose he substitutes an electric motor, with charges based upon its size and a month's constant use, he saddles himself with a fixed charge (work or play) upon his finances that bears no relation whatever to the volume of business done. It is true that many motors are employed in this and kindred industries, the users having considered the advantages of electric power over others in point of cleanness, space and convenience, but nearly always under protest as to charges. While the above case only is instanced, the illustration will apply to nine-tenths of the trades and manufactures requiring power. A slight deviation from the above is the use of the electric method for driving elevators, in which the application of power, water, steam, gas and electric, is almost universal. In view of the extensive field offered by the elevator business, power companies and motor manufacturers should not only encourage and invite the use of electric power, but should direct their energies to secure its adoption. This, like all other commercial problems, is solved only by meeting the economical requirements. There is no doubt that for elevator purposes, electric power can be furnished, at a profit, for less than almost any other application.

Suppose a business house elevator, requiring a 4 h. p. motor to be driven *constantly*, without stop, pays for ten hours a day, it must occupy one-half of its time in descending, which would mean a consumption of only 2 h. p. for ten hours—provided the load be always at a maximum. Suppose, instead of this extreme hypothesis, the elevator would be used under the same circumstances for one-half of the day—an improbable assumption—the actual power consumed would be reduced to 4 h. p. for two and one-half hours, or its equivalent, 1 h. p. for ten hours. Motor charges upon the basis of 1 h. p. at $10 per month have been adopted in several cities, notably Chicago, Milwaukee, St. Paul, New York, Baltimore, Grand Rapids and St. Louis. It will be seen at a glance that this apparently low rate, when the actual use of the elevator is considered, must leave a wide margin for the power companies. What method shall be employed to determine the amount of energy actually consumed? Naturally, recourse must be had to some forms of meter or measuring device. Much time, attention and ability is being devoted at present to designing and constructing such apparatus, but seemingly none have met yet with the approval of the scientific, and consequently the practical, branch of electrical engineering. Is it not probable that, owing to the refined graduation of which electricity is susceptible, that we are becoming finical, and are striving for the unattainable in our efforts to produce an ideal meter? What is needed is a commercial article, one that under any conditions will not entail any loss upon the power companies, and at the same time be approximately correct.

The community having its sense of justice and equity appeased would cheerfully submit to such charges as would be more profitable to the power companies than the present system. This is illustrated by the meek submission of the people to the use of the gas meter, for light and power purposes, notwithstanding the fact is well known that for truth and veracity the gas meter is, within limits, a snare and delusion so far as the consumer is concerned. The above was humorously exemplified during the recent musical festival, when a gas company, to aid in decorating the city, placed an illuminated lyre in front of its office, and was met by the query, "Why would not a gas meter have answered the purpose as well?"

The extensive experience of the writer in the motor field justifies the assertion that an early and equitable adjustment of motor charges would redound to the earning capacity of power stations by placing the electric motor on a fair footing in competition with steam, water and gas.

Notes on Artistic Incandescent Lighting.

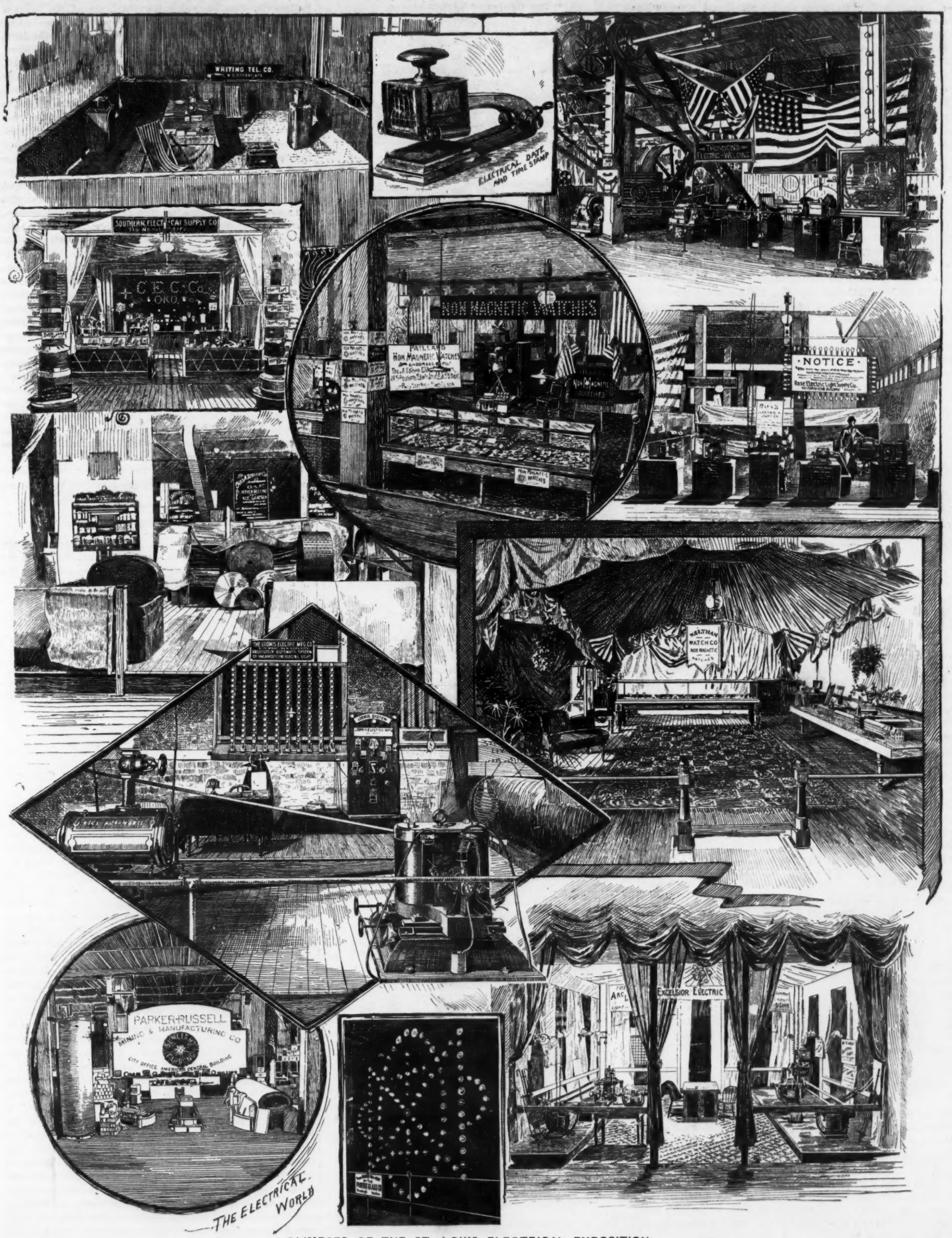
BY F. H. SODEN.

The beautiful effects secured by the artistic placing of the incandescent lamps in the Auditorium hall is something that must be seen more than once to be fully appreciated. Standing at almost any point, and looking upward, in following the curves of the vast ceiling from one side to the other by the line of lamps, you begin to wonder which is the more impressive sight, the rows of clear, soft lights or the perfect curves and beautiful decorations of the ceiling and the arches. Imagine this vast hall lighted by other methods of illumination than the electric bulb; what radical changes would have been necessary, and how the outline of ceiling and arch would have been marred by unsightly fixtures and the decorative effects lost to sight. Is it any wonder that capitalists are ready to invest large sums on the interior decorations when they have such a beautiful example to prove how worthy an assistant their architect will have in the skilled electrician with his glass bulb?

It has been remarked that the incandescent lamps in the capitol at Lansing, Mich., have given a finish and a tone to the ceiling and walls in both the Senate chamber and the House of Representatives that was sadly lacking before their introduction. Formerly these rooms contained large and expensive gas fixtures with numerous jets. Now the incandescent lamps, with small opalescent shades, are suspended four feet apart from graceful conical-shaped ornaments.

At the recent banquet tendered to the Pan-American delegates while in Chicago, many novel features in incandescent lighting were displayed, to the delight of the honored guests, among which was a miniature railway train, consisting of an engine and four coaches, lighted throughout with tiny incandescent lamps. Then there was a full-rigged ship, made of flowers, and sailing in a sea of roses, with a floral lighthouse in the distance, while tiny lamps placed at various points produced an effect that was most pleasant to witness.

The old method of placing lights on fixtures, suspended



GLIMPSES OF THE ST. LOUIS ELECTRICAL EXPOSITION.

in rooms, to within 5½ to 7 feet of the floor, is going into disuse, as to obtain perfect illumination lights should be placed above and out of the direct line of the eyes, and we should obtain light by reflected rays wherever possible. In some instances perfect illumination has been secured without the source being prominently indicated, and it is a question if there is not an unexplored field in the matter of lighting large halls with the rays from arc lamps that are concealed from sight. To obtain the best effects, the decoration of the ceiling should always be in the lighter, rather than the darker, colors, so as to reflect rather than to absorb the light. The fixtures should be symmetrical and in harmony with the interior finish, and so placed that shadows will not be cast on ceiling or wall, and the same care exercised in selecting globes and shades. The incandescent bulb in no way detracts from any form of decoration, but proves invaluable to the artistic decorator in furthering his designs for the ornamentation of the interior of public and private buildings, and thus by uniting their efforts, architect, decorator and electrical engineer can secure effects that in the past would have been deemed impossible.

Here is an inviting field for the practical young mnn of artistic tastes and sympathies just graduating from the college where he has taken his course in electrical engineering. And it is a field that will never be overrun.

Glimpses of the Recent St. Louis Electrical Exposition.

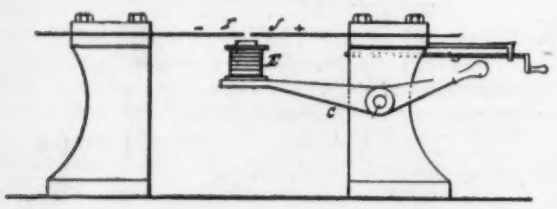
The electrical exposition held at St. Louis in the fall of last year was so very successful in demonstrating the merits of that city for exhibitional purposes in that line, and for distributing electrical goods to a large constituency, that it has now been decided to hold the exposition again

this year, on an even larger scale. St. Louis, even with its wonderful 1000-mile radius, may not capture the World's Fair, but it will find no small compensation and consolation in the attractiveness of the proposed electrical display.

At the time of the Exposition of 1889, our Western correspondent, Mr. F. de Land, made copious notes of the various exhibits, and there is no need to go over the ground in detail now, especially as our excellent group of sketches on page 71 gives an excellent idea of some of the leading features. The top left hand vignette is the exhibit of the Writing Telegraph Company; next to it is the stamp shown by the Electric Date and Time Stamp company of St. Louis. To the right is the display of the Thomson Welding Companp. At the left again is the attractive combined exhibit of the Southern Electrical Supply Company and the Central Electric Construction company, not forgetting the popular and ubiquitous "Okonite." Then there is the exhibit of the Rose Electric Light Supply Company, of St. Louis; and, between, is the very handsome "watch store" of the Non-Magnetic Watch Company, of New York. Just below is the display of non-magnetic watches of the Waltham Watch Company. The belting trade is well represented by the exhibit of Chas. A. Schieren & Co., of New York, including all their specialties. The diamond vignette is occupied by the Loomis Electric Manufacturing Company, of New York, who ran a 300 incandescent machine to light the cascade, fountain, etc., and also operated several motors. To this is attached the medallion containing the display of the Parker-Russell Mining and Manufacturing Company, of St. Louis, of their "Sunlight" carbons, and next to this is the quaint, geometrical grouping of the rich electric glassware of the Phœnix Glass Company, of Pittsburgh and New York. The whole closes fittingly with "Excelsior," as typified in the exhibit of the Excelsior Electric Company, who, through their Western branch, made a brave display of their well-known motors, generators, switches, rheostats, etc. Those who visited the Exposition will readily admit that our artist has made a very faithful and vivid picture of the subjects selected.

Coffin's Method of Electric Welding.

A number of interesting phenomena have been brought to light in connection with the operation of electric welding as developed by Prof. Elihu Thomson, and described by him in our columns from time to time. To these we must



Coffin's Method of Electric Welding.

now add another, the discovery of which is claimed by Mr. Ch. L. Coffin, of Detroit, and for which a patent has just been issued to him. The inventor proceeds in the regular way, as shown in the accompanying illustration, by pressing the ends of the pieces *I J* together; but instead of relying merely upon the resistance of the contact to generate the welding heat required, Mr. Coffin claims to have discovered that by subjecting the joint to the influence of a magnet *E* acting across the path of the current, the electrical resistance of the joint is secured and the heating effect of the current becomes greater.

Mr. Coffin has also found that after the two pieces have been joined together a better weld may be obtained, by ceasing to press the joint together and applying stress tending to separate the joint while the current is still passing, taking care, however, not to rupture the weld. This action is claimed to increase the electrical resistance of the joint, and consequently to increase the heat. This force is only applied for a short time, and the joint is finished as usual by rolling or hammering.

Leclanche Cells on Closed Circuit.

To the Editors of The Electrical World:

A friend and I have been arguing on the following question, but have reached no definite conclusion and would like to have some information on the subject. If, we will say, two cells of the Leclanché battery were to be short-circuited by a wire from 5,000 to 6,000 feet in length, would the wire have sufficient resistance to admit of the cells being run on a closed circuit; that is, would the battery run down in a short time? Geo. Sweisfort.

Philadelphia.

Answer.—Without knowing the *diameter* of the wire and its nature, it would be impossible to answer this question. In our last issue there was described a closed circuit burglar alarm system, in which a single Leclanché cell was operated successfully on a closed circuit through a resistance of 2,590 ohms, consisting of a coil of No. 34 B. & S. gauge copper wire, whose length would be equal to about 13,700 feet. Two cells of Leclanché in series would necessitate twice that resistance. It is probable that the cells would not polarize with a resistance less than that given, say in the neighborhood of 1,500 ohms to each cell; but the consumption of zinc would be increased proportionally and the cells require more frequent attention than with the higher resistance.—Eds. E. W.

"The Genius of Light" Statue.

One of the recent additions to the library of the beautiful Edison Laboratory, at Orange, N. J., is a piece of marble statuary, called "The Genius of Light." It was seen by Mr. Edison while abroad and was immediately purchased. It was done at Rome in 1888, by A. Bordiga. We give on this page an illustration of the statue, which is just over 6 feet in height, and stands upon a pedestal about 3 feet high. The figure is that of a graceful youth, who, supporting

"The Genius of Light" Statue.

himself lightly on a broken gas-lamp, holds aloft an incandescent bulb, reminding one of a passage from Shelley's lines "To the Sun":

". . . . . whence arise
And are shot forth afar clear beams of light;
His countenance, with radiant glory bright,
Beneath his graceful locks, far shines around;
And the light vest with which his limbs are bound,
Of woof ethereal, delicately twined,
Glows in the stream of the uplifting wind."

The sculptor might well have had these lines in mind when he chiseled this figure. At the youth's feet is a Volta pile, from which apparently the current is derived for the lamp. Beside it lies a rough telegraph key, and behind the figure is a telephone, while to the right is a crude, primitive form of magneto armature. The whole is a vigorous and charming piece of work.

This statue has been placed in the centre of the library, where it faces the doorway, and is thus the first thing seen by the visitor as he enters. Mr. Edison has had a 100 c. p. lamp placed in the uplifted hand.

A Novel Electric Water Level Indicator.

The maintenance of the correct water level in boilers is evidently a most important point in their operation, and the majority of accidents due to the explosion of boilers

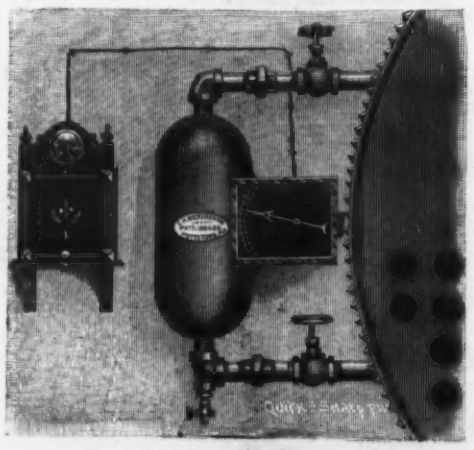


Fig. 1.—Wickersham's Electric Boiler Alarm.

may probably be traced to lack of attention on this score. Even if no explosion takes place, the boiler may be seriously damaged and weakened by low water, which results in burnt tubes and sheets. The indicators which inform the attendant of the condition of the water in the boiler are usually of a visual character, being generally a water tube; but as the fireman is often charged with other duties, and not always able to see the tube, an audible signal is often desirable to inform him that the boiler needs attention.

A novel arrangement to effect this object has recently been brought out by Messrs. Janney and Wickersham, of Pottstown, Pa., in which the condition of the boiler is signaled automatically by means of electric devices.

The accompanying illustration, Fig. 1, shows the level indicator as attached to a boiler, and Figs. 2 and 3 show the electrical and mechanical details. As will be seen, when the circuit is closed at the boiler by the water reaching either the "high" or the "low" danger point at which the column device has been set, it is immediately broken by an automatic circuit breaker in the annunciator circuit. Thus no matter how long the water remains at the "high" or "low" point, there is no current passing. This allows of the use of an open circuit battery, and hence involves practically no attendance on the battery.

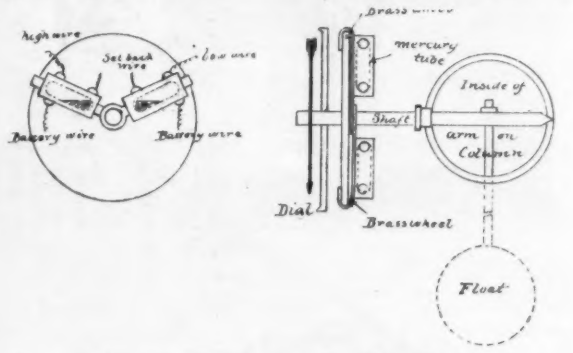
The breaking of the circuit at the annunciator has no effect on the indicating needle, which continues to give the proper indications after the circuit has been broken, and as long as the water is too high or too low; but the needle is automatically "set back" when the water reaches a safe level.

The circuit closers at the boiler are outside of the column, and, consequently, are not subject to the action of the steam and hot water. They are also air-tight and dust-proof. They consist, as will be seen in Fig. 2, of two glass tubes, with platinum wires blown in and partly filled with mercury, the air being exhausted from the tube. These tubes are incased in blocks of wood, and the wires are brought out to binding screws on the outside of the blocks. Two tubes are used, one for "high" and the other for "low." The blocks are fastened to a small brass wheel by means of clamp springs, and are adjustable by hand, so that the high and low points of alarm may be altered as desired. The wheel is controlled by a large float in the column, the shaft of the wheel passing through a small stuffing-box to the inside of the column.

The large needle on the column points at the centre of the float and shows the exact level of the water at all times.

The Photo-Engraver's Assistant.

In commercial photo-engraving, zinc etching and the gelatine relief process, it is absolutely necessary that the exposure be properly timed, the period depending on the



Figs. 2 and 3.—Wickersham's Electric Boiler Alarm.

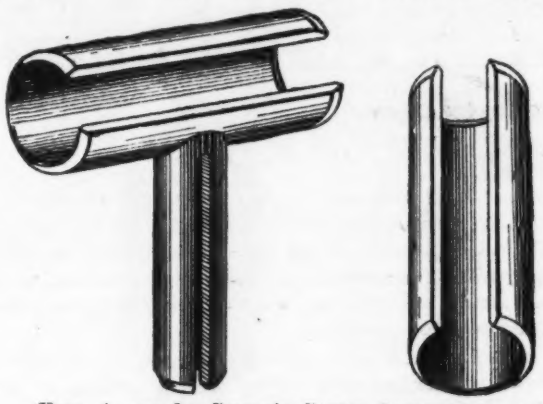
depth of shading required. Any increase in the duration of the exposure will cause what is termed an "overprint," a piece of work that rarely gives satisfaction, as the finer lines of the original are not reproduced. On being placed in charge of the relief gelatine process, some years ago, Mr. William A. Blomgren, of Blomgren Bros., Chicago, found that the best of assistants would sometimes fail to remove the plate at the correct time, causing an annoying loss of time and material; so he devised an electric alarm that has proven an economical and a truthful assistant, and one that leaves the operator free to attend to other duties without fear of neglecting or over-exposing the plate. So satisfactory has been its service that the company have one connected to each of their three or more copying cameras.

The device, in brief, consists of an ordinary clock movement (an eight-day being preferable, as one winding a week suffices) having a special form of dial with sixty points indicating minutes traced thereon, around which revolves one hand in unison with the movements of the clock, while a second hand, insulated from the other, is moved to any desired point at the will of the operator. This latter hand is close to the dial. Both hands have platinum points that make a rubbing contact when the minute hand passes over the quiescent hand. From the latter a wire passes to a battery consisting of two cells of Gonda-Leclanché, that is connected to a vibrating bell, and from which a wire passes to the minute hand. Thus when an exposure is to be limited to, say, six minutes, the still hand is moved six minutes in advance of the minute hand, and when the latter reaches that point it closes the circuit and causes several strokes of the bell to ring out while rubbing past, and notifying the assistant to change the plate. A further improvement of especial value to the operator temporarily left without an assistant is a small coil and armature placed above the inner face of the lens within the camera, and connected in the circuit with the clock and bell. When the circuit is open, a shutter or blind is lightly supported by the armature of the coil, and is released and allowed to fall on the closing of the circuit, thus preventing further exposure, and allowing the operator to continue on in any special form of work that he may be unable to lay aside at the moment. These devices will shortly be placed on the market by a Chicago company.

Seely's Electric Connector.

The experience of the past has shown that too much care cannot be bestowed upon the joints in electrical conductors, especially those laid underground or entirely submerged in water, and that an otherwise perfect cable or insulated conductor may be rendered utterly useless by slight neglect in this direction. In the jointing of a large number of the electric light cables laid underground in this city a form of connector has been employed which was designed by Mr. John A. Seely, of the Seely Manufacturing Company, of New York, and which was specially devised to be used in connection with lead-covered cables. The joint as made for taking off a branch circuit has the general form of a T, as shown in Fig. 1; but its parts are open or slit to facilitate the connection with the wires. The wires when once adjusted are sweated in by solder, which flows into the slits of the joint and forms a solid connection and good electrical contact. The ends of the joint which abut against the fibrous insulation of the conductors are double beveled and rounded to prevent abrasion of the insulation. This obviates a fault in the ordinary T-couplings, which are usually made rough, and it has been found that the square ends are sometimes armed with a burr, which cuts through the insulation, thus admitting water and causing a ground or a short circuit.

Our engraving, Fig. 2, shows the joint as applied to the cable when a branch circuit is taken off, and Fig. 3 illustrates a connector designed for a straight joint. In the operation of making a connection a section of the lead



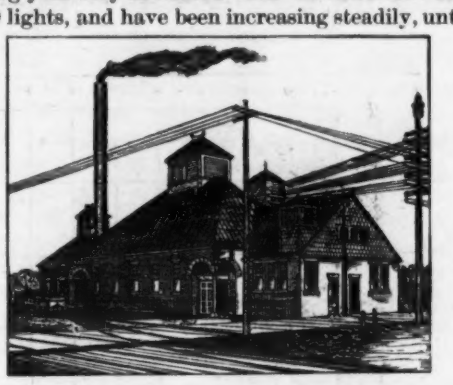
FIGS. 1 AND 3.—SEELY'S CABLE CONNECTOR.

sheathing is removed from the main. The fibrous insulation is then cut away or tapered toward the middle of the opening, and finally enough of it is entirely removed to expose the length of conductor which is to be covered by the joint. The joint is then passed under the wire and brought up until it surrounds the same, when, by the use of a pair of pliers, the tube is bent up and around the conductors until the edges of the slit nearly meet. The branch, the end of which has been exposed, is then pushed into the lateral stem of the joint, and the pliers again used, if necessary, to bring up the sides of the tube against the wire. The joint having been placed in position, solder is poured into the slits, which flows around the conductor and makes good contact between the parts, besides sealing the joints. This done, the joint is wrapped with suitable insulating tape or compound. The rounded edges prevent any abrasion of the insulating material.

Although specially designed for use in connection with lead-covered cables, the connector is evidently equally well adapted to other conductors, and for general purposes is made in a large number of sizes.

El Paso Company's Station, Colorado Springs, Col.

We illustrate herewith the station of the El Paso Electric Company at Colorado Springs, Col. The plant was started Nov. 1, 1886, with a capacity of 600 lights, and only running 200 lights of the Westinghouse three wire system. The equipment consisted of one 90 h. p. boiler, two 45 h. p. Westinghouse automatic engines, and two 300-light Westinghouse dynamos. In October following they built the station shown, and changed their system to the Westinghouse alternating. The plant then consisted of two 45 h. p. and two 75 h. p. engines, and two Thomson-Houston arc dynamos of a capacity of 50 lights were added. They ran at that time 800 incandescent lights and 30 arcs. The following year they increased their incandescent capacity to 1,800 lights, and have been increasing steadily, until now



THE EL PASO STATION, COLORADO SPRINGS, COL.

they have a capacity of 100 arcs and 4,000 incandescent lights in a town of 10,000 inhabitants.

Their plant is located alongside the railroad track, twelve miles from Old Pike's Peak. Their coal is unloaded in front of the boilers. The boiler room is 60 × 45, with two 200 h. p. Babcock & Wilcox boilers and four 80 h. p. tubulars. The dynamo room is 120 × 60 feet, and contains two 80 h. p. Westinghouse compound engines, two 45 h. p. and three 75 h. p. Westinghouse standard engines, two 50 light Thomson-Houston arc dynamos, and five 750-light Westinghouse alternating dynamos. The company think they have as complete a station as can be found in the West. The officers are as follows: C. H. White, president; O. L. Godfrey, secretary; E. E. Wade, general manager and superintendent; M. Tristor, electrician, and W. S. Butler, engineer.

The Young Automatic Safety Cut-Out.

The liability of breaks occurring on live wires, and the necessity that often arises in large cities in case of fire to cut electric light wires to facilitate the movements of the firemen, has created a demand for something that under such circumstances will render the circuit perfectly harmless to those who are obliged to come in contact with the wires. And again, the broken ends of the circuit may fall across other conductors or on tin roofs and maintain the circuit complete, which may result in dangerous crosses.

To avoid this and to effect the immediate cessation of current on the breaking of the circuit, the Schuyler Electric Company, of Middletown, Conn., have brought out the Young automatic circuit breaker or safety cut-out which we illustrate in the accompanying engravings.

The circuit breaker is composed of two single electro-magnets *M M*, the bobbins of which are of metal. One end of the wire with which the magnets are wound is permanently connected to the metal bobbin, while the free or outside wire is carried to the binding posts *A'* and *B'* respectively; the circuit breaking levers *D D* make contact on the bottom of the magnets *M M*, and are held in position until current is started by automatic latches *C C*. A flexible cable connects the levers *D D* with binding posts *A* and *B*, and the dynamo terminals are connected to binding posts *A'* and *B'* and the line to *A* and *B*.

The circuit breaker being in the position shown in Fig. 1, is ready for the dynamo to be started. As soon as current is generated by the dynamo, the armatures of the latches *C C* are drawn to the electro magnets *M M*, thus leaving the breaking levers *D D* free, they being now held in place by the magnets *M M*, as shown in Fig. 2.

The path of the current is from the dynamo terminals to binding post *A'*, to magnet *M*, then through breaking lever to the binding-post *A*, to line, to binding-post *B*, breaking lever *D* and magnet *M*, to binding post *B'* and to dynamo. thus completing the circuit.

Should the line be cut or broken for any reason, the magnets *M M* instantly become demagnetized and the levers *D D* drop from contact with the magnet cores, thus automatically, instantly rupturing the line at two points, as shown in Fig. 3. Before again closing the circuit breaker, which is done by raising both levers with circuit closer *E*, the dynamo attendant or linemen hunt up the cause of the trouble, and the breaker is not closed until the difficulty has been found and remedied.

Where several dynamos are in one station, the circuit breakers can be attached to an annunciator, so that the attendant may instantly be informed on which line the trouble exists and take immediate steps to correct it. The desirability of this apparatus in all large stations, and especially in cities, will be apparent to all station managers, who will be simply doing their duty in equipping their plants with such an appliance.

This device is the invention of Mr. C. Griffiths Young, of the Mt. Morris Electric Light Company of this city, and it is controlled by the Royal Electric Specialty Company, for whom it will be manufactured by the Schuyler Electric Company, of Middleton, Conn.

The Illinois Electric Lighting Association.

A meeting of the representatives of central station companies, called for the purpose of organizing a State Association, was held in the rooms of the Chicago Electric

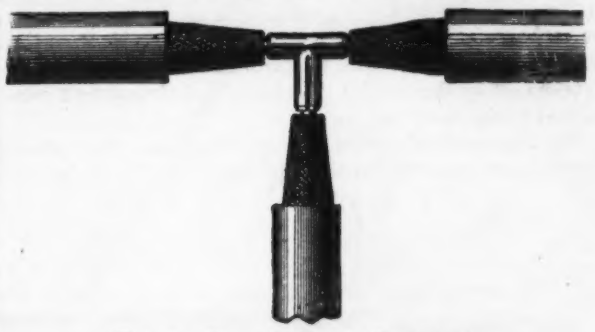
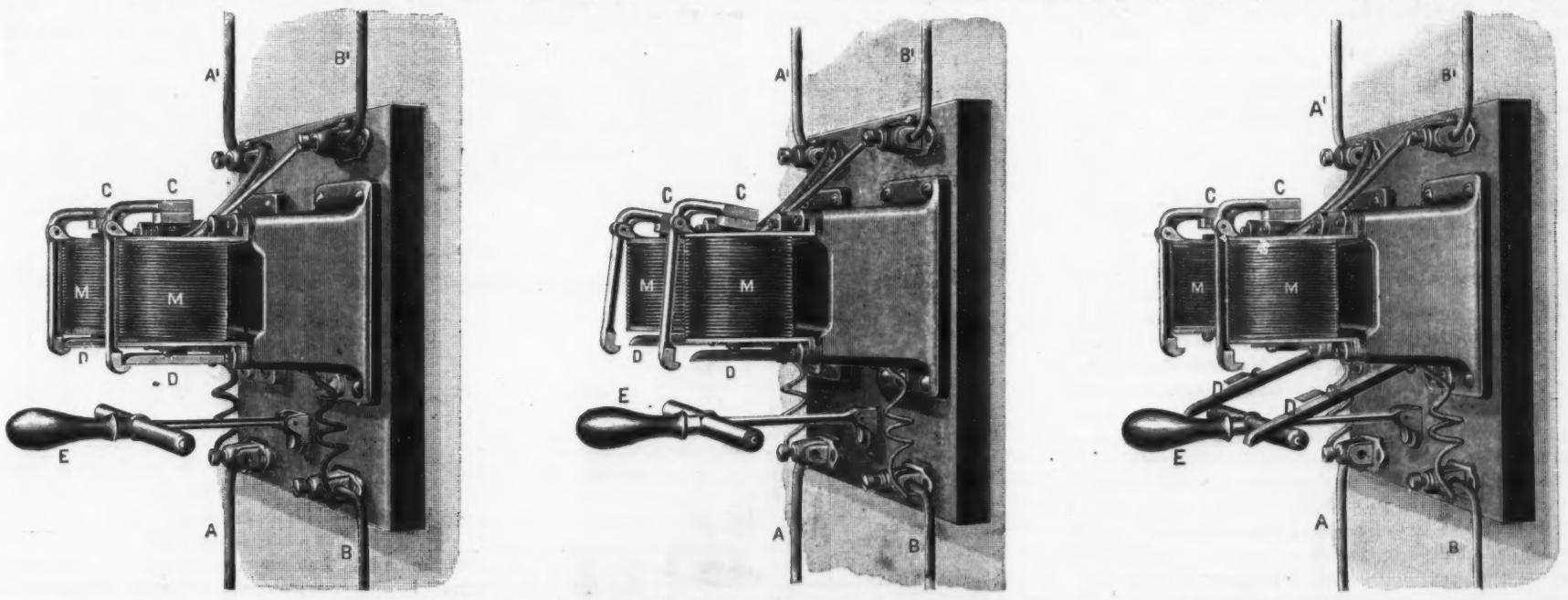


FIG. 2.—SEELY'S CABLE CONNECTOR.

Club, Saturday, Jan. 18. The objects of the movement having been fully discussed, it was resolved to effect the organization at once. This was done by the adoption of a constitution and the election of the following officers: President, C. H. Wilmerding, secretary and treasurer Chicago Arc Light and Power Company; First Vice-President, A. L. Ide, president Springfield Electric Light and Power Company; Second Vice-President, Dougles Hapeman, secretary and treasurer Ottawa Electric Light and Power Company; Secretary and Treasurer, Chas. E. Gregory, Sun Electric Light Company, Chicago; Executive Committee, C. H. Wilmerding, Chicago; A. L. Ide, Springfield; Douglas Hapeman, Ottawa; Chas. T. Page, Englewood, and M. A. Beal, Rockford.

Mr. Page is secretary and treasurer of the Englewood Electric Light Company. Mr. Beal is secretary and treasurer of the Forest City Electric Light and Power Company, at Rockford.

A resolution was passed directing the secretary to have the constitution printed, also blank form of application for membership, and a form to secure sundry items of data, and send copies of the same to every company, firm or person in the State eligible to membership, with a letter inviting them to become members of the association as organized. It is expected that this association will develop into one of the largest State associations in the country There is a sufficient number of local companies in the State to supply the material.



FIGS. 1, 2 AND 3.—THE YOUNG AUTOMATIC SAFETY CUT-OUT OR CIRCUIT BREAKER FOR DYNAMO CURRENTS.

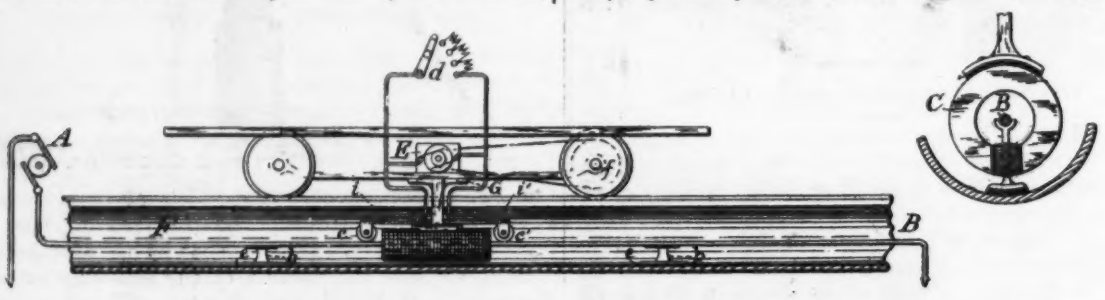
Dewey's Series Electric Railway System.

One of the objections which has in the past been raised against the series method of operating electric railways is the fact that it was necessary to make and break the circuit at frequent intervals, which detracted from the advantages otherwise claimed for this system. With the object of removing this difficulty, Mr. Mark W. Dewey, the electrician of the Dewey Corporation, of Syracuse, N. Y., has devised a method by which the conductor connected with the generator at the station remains unbroken. This is accomplished by means of a simple counter-electromotive force device carried by the car and between the terminals of the vehicle conductor, and moving in contact with the working conductor; the current passing in the working conductor is thus intercepted, and the small portion of the working conductor located and maintained between the moving contacts is made substantially non-conducting, compelling the current to flow through the vehicle couductor, including the propelling motor.

Various devices may be employed to create electrical resistance or stress, or for setting up counter-electromotive force, or a tendency thereto, in the line-working conductor, but the device actually employed for the purpose consists of a sheath of laminated magnetic material *C*, Figs. 1 and 2, as iron or steel, surrounding the line conductor and supported and carried by the car. A longitudinal slot is provided through the sheath to permit the supports of the conductor to pass through; and in order to obtain the maximum effect from the device, the supports are made of the same material as the sheath, and flexible iron or steel brushes are fixed to the sides of the slot and extend transversely across the latter to maintain the same constantly closed, and forming a closed magnetic circuit around the conductor.

The proximity of the iron around the conductor generates or rather concentrates a heavy counter E. M. F. at the ends of the section of wire so surrounded, which E. M. F. is taken off by the contact wheels *c c'* and the current conducted to the motor on the car.

An alternating current is employed, and alternating current motors for the cars are preferred by the inventor,



FIGS. 1 AND 2.—DEWEY'S SERIES ELECTRIC RAILWAY SYSTEM.

but where a road is already equipped with direct current motors, and it is not desirable to change, the alternating current on the car may be automatically rectified or straightened by simple well known devices, and the direct current motors used.

The system, it is claimed, is adapted equally well for underground and overhead systems, and permits of operating the cars in series without breaking the circuit in any part.

The Electric Motor and its Relation to Electric Lighting Companies.

BY WM. H. FITZGERALD, DETROIT.

Very few of our central station managers realize what an important factor in the earnings of a central station the electric motor can be made, and what wonderful proportions the use of this most convenient and reliable method of distributing power has reached.

In the spring of 1884, being in New York, I remember seeing in the office of a wiring firm, near the Edison station in Pearl street, one of the first electric motors of the Sprague type, it being the first electric motor adapted to practical work I had ever seen; and I remember well the statement of one of the firm that they had been asked to exploit the sale of the motors, but doubted if they could ever be made a success, owing to the expense of operating them. I was told that there was one in operation in Ann street, and I went there to see it. The sight of this little giant at work filled me with wonder and amazement, and to this day I cannot but marvel at every motor installation which I see, and at the ease and convenience with which they operate.

There are to-day in operation in the United States, as near as I am able to learn, stationary electric motors aggregating between 5,000 and 10,000 h. p., besides probably 6,000 to 8,000 ½ h. p. motors, fan outfits, etc. The confidence of the public in the electric motor as the most reliable and economical power available is now an assured fact, which is becoming more evident every day by the inquiries for power from shops and factories using from 20 to 100 h. p., and even higher.

Among the larger factories being operated entirely by electric motors are the following: Hickok Manufacturing Company, Harrisburg, Pa., employing 200 hands, operated by C. & C. motors; Globe Tobacco Company, Detroit, Mich., employing 140 hands, operated by Eddy motors; Huyler's candy factory, New York, employing 200 hands, operated by C. & C. motors.

The factory of the C. & C. Electric Motor Company, employing 150 hands, is operated, of course, by their own motors. In these four factories there are nearly 300 h. p. in motors.

With the astonishing growth of this industry for the past year or two in view, let us see what are the best means for a central station to adopt to profitably supply this large demand for electric power which is bound to come, and what are the methods which past experience and prospective practice would suggest. The facts here developed apply principally to stations operating day circuits. The accompanying diagram, Fig. 1, represents about an average load diagram, as taken from the ampère meters of a constant potential station supplying about 5,000 incandescent lights; Fig. 2 is an imaginary load diagram of a constant current station supplying 250 all-night arc lights, 50 twelve o'clock lights, 150 ten o'clock lights and 50 day lights, each station having an engine capacity of 500 h. p.

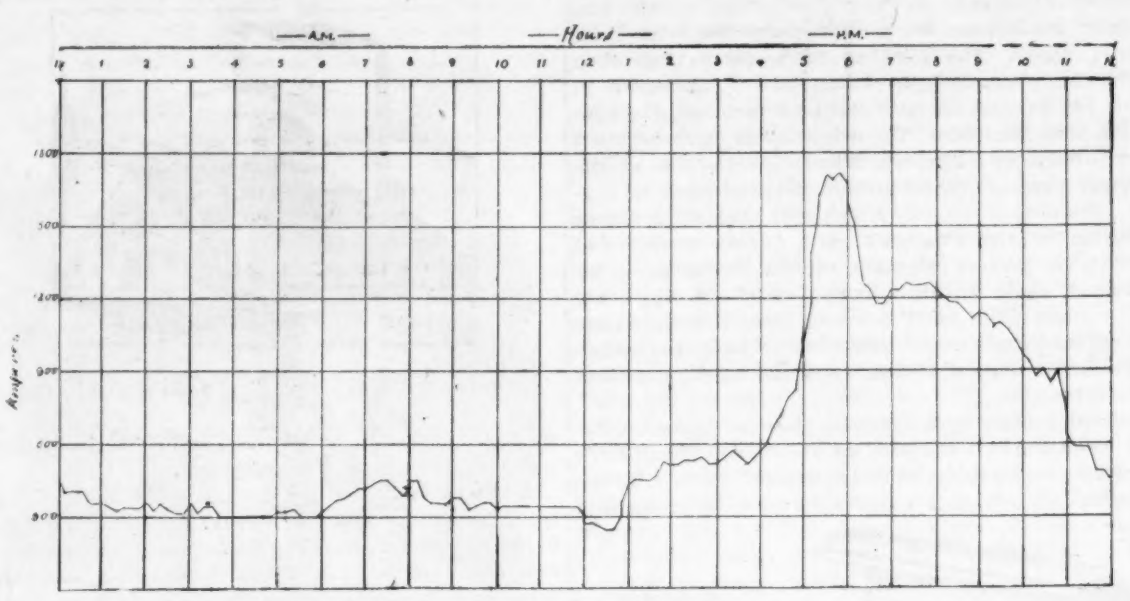


FIG. 1.—AN AVERAGE LOAD DIAGRAM.

It will be readily seen by an examination of these diagrams that in neither case is the average load of the station more than 40 per cent. of the maximum; in other words, 60 per cent. of the station is on an average idle, while 40 per cent. is compelled to earn interest on the investment in the entire plant. Assuming these conditions for the sake of illustration, let us see how cheaply we can afford to sell power. We will estimate the cost of this station at $50,000; $30,000 of this investment, or 60 per cent. on an average, we have available for power uses, represented by 300 h. p., and we will estimate the cost of the motor circuit at $5,000.

EXPENSE.

Six per cent. on $30,000 investment per month	$150.00
Five per cent. wear and tear	125.00
300 h. p., at 5 lbs. coal per h. p., 15,000 lbs. per day, or 195 tons for 26 days of 19 hours each, at $3	585.00
Six per cent. on $5,000, cost of motor circuit per month	25.00
Oil and waste	25.00
Extra fireman	60.00
	$970.00

Three hundred horse power generated in the station, therefore, costs $970 or $3.23 per horse power per month. It is, however, a well authenticated fact that 1½ h. p. at least in the rated capacity of the motors can be sold for every horse power generated in the station, which makes a cost to the station of but $2.16 per month per rated horse power of the motors on the circuit.

I have not added in this cost the expense of an engineer, dynamo man or line man. Those we are obliged to have for the day service. By operating the station nearer to the maximum of its total capacity, we are enabled to use large engines instead of small ones, and obtain a consequent higher fuel economy, thereby operating the day lights at a considerably decreased cost per lamp per hour.

It is out of the question to imagine that these results can be obtained from a series or constant current circuit for operating the motors. My experience of the past eight years with series circuits convinces me it cannot be done. There are five important and absolutely necessary elements in a successful power distribution. First, reliable and continuous service. Second, uniformity of speed in the motor. Third, the highest possible efficiency with a minimum cost for repairs. Fourth, perfect safety to the user. Fifth,

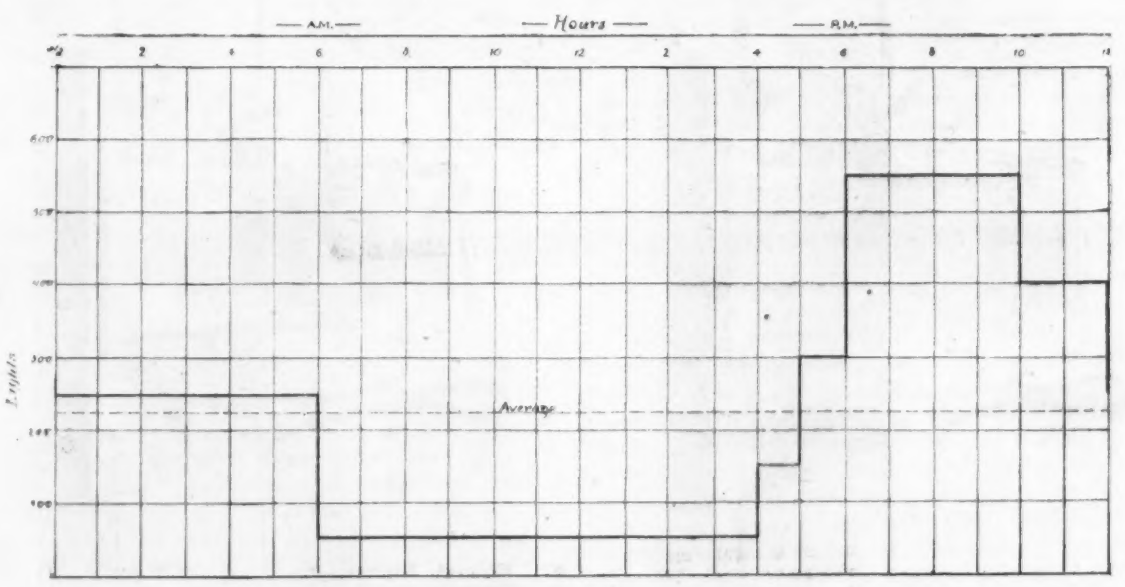


FIG. 2.—AN IMAGINARY LOAD DIAGRAM.

profit to the station. Let us consider these conditions first as related to a series circuit.

The continuity of the service depends upon the care with which each subscriber operates his motor; therefore each subscriber added to the circuit increases the possibility of opening the entire circuit. I have in mind the case of a tailor who, finding his motor out of order, thought to repair it himself. His first move was to deliberately remove one of the line wires from the binding post of the motor, thus unconsciously shutting down the entire circuit. The tailor shop was one of the last places to which the lineman went in hunting up the trouble on the circuit, which was shut down some three hours in consequence; and the quantity and the quality of the complaints, because of this stoppage, only the central station manager

can appreciate. This is only one of the many causes of stoppage in a series circuit which make it unreliable for power uses.

The regulation of speed in the constant current motor of to-day is a commercial success while the regulator is kept in good order. The regulation of speed by mechanical means implies the necessity of constant care and attention. Lacking this they become a source of constant complaint because of their poor regulation.

The efficiency of the series motor is comparatively low, and the cost for repairs due to the mechanical complication of the motors, as well as the lack of safety devices on the circuit to protect the motor in case of an abnormal increase of current on the circuit, makes the repair account high.

The matter of safety in the use of a motor on a series circuit need not be discussed here. Suffice it to say that thus far their use has been remarkably free from accident.

Now, with regard to prospective profits on a constant current or series circuit absorbing 60 h. p. at full load in the station, my experience shows that it is not safe to place over 40 h. p. in the rated capacity of motors, where the motors average over one or two horse power. This makes $4.84 as the cost per horse power per month on the rated capacity of the motors on the circuit.

The same conditions as related to a constant potential circuit appear about as follows :

The stoppage or break down of one customer can, under no possible conditions, affect the rest of the circuit.

Devoid of all mechanical complications, the regulation of speed in the motor is simply perfect, and the repairs on a first-class motor I would insure at five per cent. per annum, and expect to make fifty per cent. on my risk.

Two or three hundred volts for stations covering short distances are perfectly safe potentials to operate with.

We can safely place two horse power in motors on a constant potential circuit to one on a constant current circuit with an equal initial horse power in the station. This fact alone should be sufficient to decide the central station manager in favor of a constant potential power circuit.

Having decided upon the best system to use, let us now determine the best and most comprehensive method for selling this power. We have passed the day of ceiling fans, fan outfits, exhaust fans, dental engines and the general run of ¼ h. p. motor work, and must prepare ourselves to do a power business with business men. Not that the small motor work is not desirable and profitable, but we must now look for 80 h. p. installations rather than ½ h. p. If we secure the large ones the small ones will come of themselves.

The prices for steam or belt power vary from $60 to $100 per year per horse power for intermittent work, according to the locality. Let us suppose we take a contract to furnish current to a factory operating 50 h. p. in motors at the rate of $50 per year per horse power. Prevailing records will amply justify the statement that not over six-tenths of this power will be used on an average, many cases running as low as from three to five-tenths. Allowing six-tenths as the average, in this case we would then actually deliver to this customer thirty mechanical horse power. What would be the profit on this work? Assuming 5 per cent. as the loss by friction in the engine, 10 per cent. in the dynamo, 10 per cent in the circuit, and ten per cent. in the motor, we would deliver 69.3 per cent., say 70 per cent., of our initial power to the work. The cost of our initial horse power was $3.23 per month or $38.76 per year, which would be 70 per cent. of the cost of the actual horse power delivered; making a cost of the delivered horse power $55.30 per year, and of 30 h. p., $1,659. The receipts from this installation would be $2,500, or a profit of $841, equal to $28 per horse power on the power actually delivered. Fifty to sixty dollars per year per horse power based on the indicated horse power of the motors is, in my opinion, a fair price at which to sell electric power in units above 20 or 30 h. p. Smaller units than this readily command higher prices; the price, of course, increasing as the units decrease in size.

The next question which arises is, How to sell these motors, or rather the best method of introducing them. In many instances the central station takes no hand in the sale of motors. This, I think, is a mistake and a detriment to the company as well as oftentimes to the user. I have learned of one make of motor of 15 h. p. capacity which required 22 ampères to run it without a load, while the motors which we sell of 15 h. p. capacity take about 4½ ampères to operate them under similar conditions. Now, I cannot afford to supply current for the 22 ampère machines at the same price per rated horse power that I would charge for the 4½ ampère machine, neither can I explain this difference in a satisfactory manner to the prospective buyer, and, as a result, he is dissatisfied. The salesman who is offering the 22-ampère machine assures him, of course, that this is the best machine made. Where there are three and four and sometimes more motor salesmen in a town, by the time the prospective buyer has had a call from them all, he is ready to believe that a motor may be made either of iron or green cheese, and that the electric light company will sell him ampères by the bushel and volts by the long ton, and is generally demoralized, and as a result buys a gas machine.

This is a condition of affairs which must be avoided; therefore the central station should handle the very best motor they can buy, and thus supply the user with a complete installation under suitable guarantees, etc.

The profits from the sale of these motors is also a considerable item, though it is sometimes worth while to give the customer this profit where his use of power offers a good prospective profit.

To sum up, I would advise the use of a constant potential circuit of not over 500 or 600 volts. Secure some large power users, if possible, and sell them power cheap. Control the motor sales or rentals yourself, and use only the best motor to be found, for you will find that with motors, as with most everything else, the best is the cheapest.

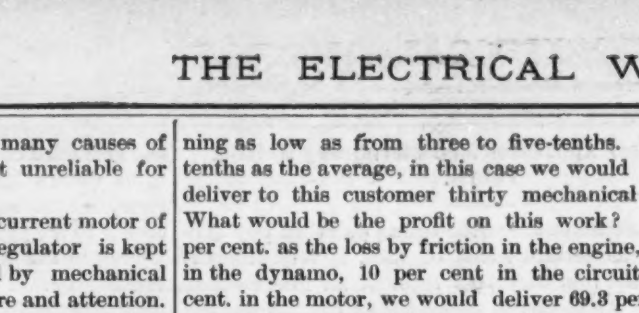
A Novel Lag Screw Wrench.

Our illustration represents a very useful tool designed by by the Lowell Wrench Company, of Worcester, Mass., to facilitate the driving of lag screws, so often required in line construction and other electrical work. The tool is in reality a combined screw driver and wrench. So long as the screw runs easily, it can be turned by the wooden handle more conveniently and faster than by the fingers, and independently of the ratchet motion. When this can no longer be done with ease, the 12-inch handle is brought into use to turn the screw home. All this can be accomplished without removing the wrench, and hence allowing of quick and accurate work without incurring the danger of bruised fingers.

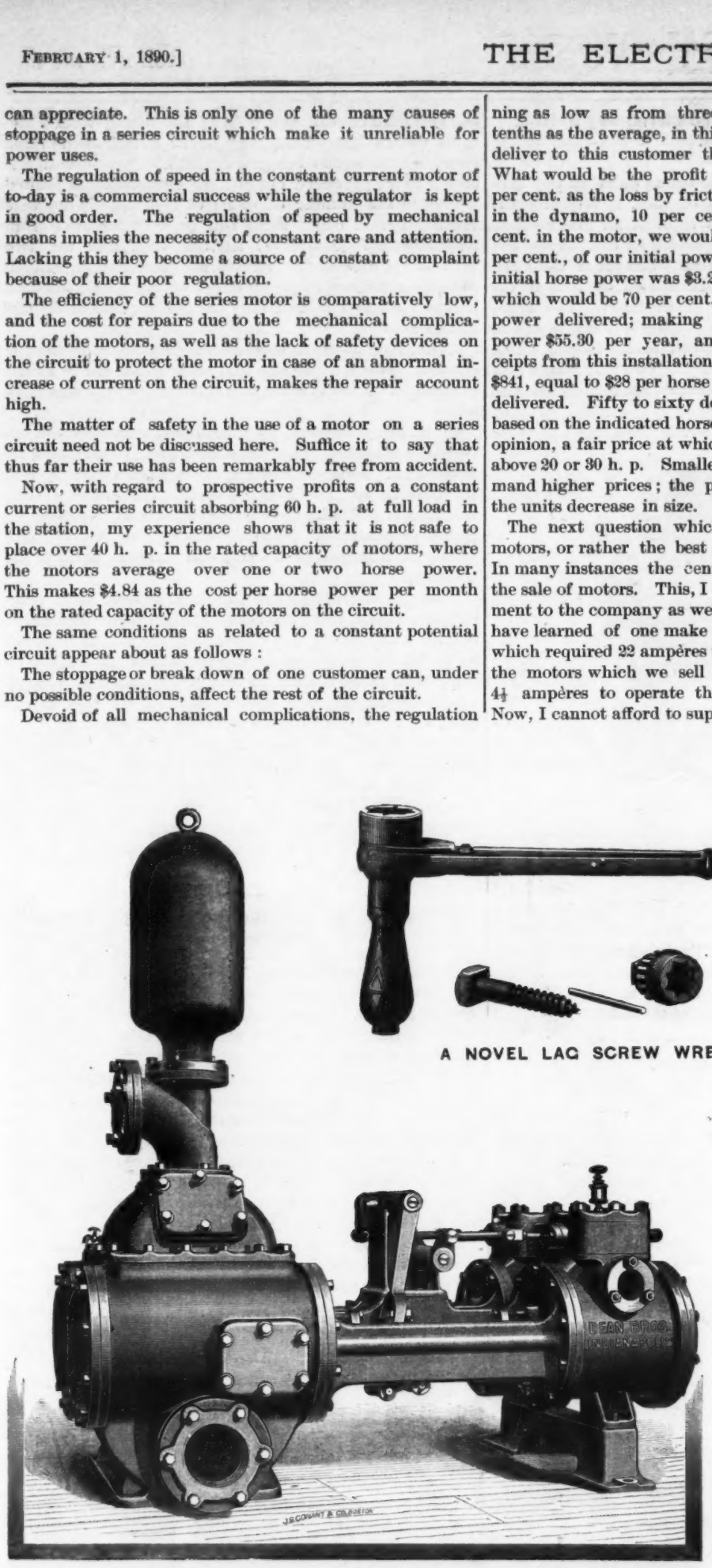
Dean Brothers' Duplex Steam Pumps.

We illustrate on this page a form of steam pump that is found in many of the electric light and power stations in the Western states, and which has gained a national reputation for excellency and workmanship, all the parts being unusually strong and well fitted. The double acting plungers work through deep packing rings of hard composition, while all parts subject to wear can be easily renewed.

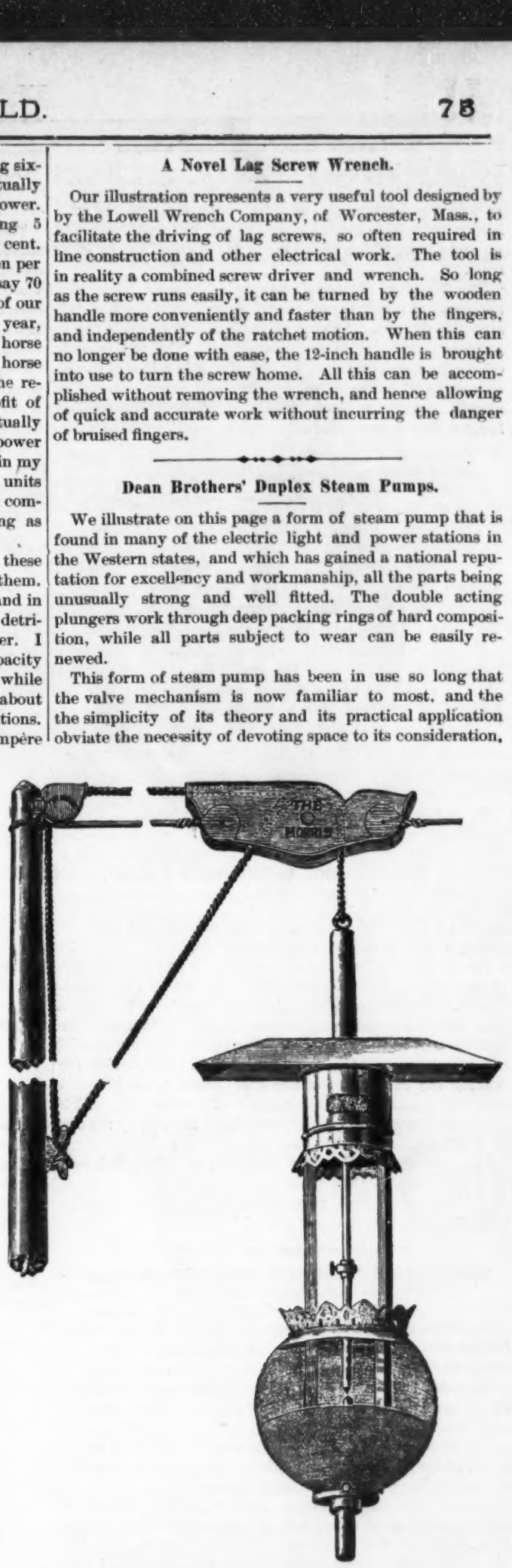
This form of steam pump has been in use so long that the valve mechanism is now familiar to most, and the the simplicity of its theory and its practical application obviate the necessity of devoting space to its consideration. Two direct-acting pumps are placed side by side, and so connected that the steam valve of either pump is moved by its companion. The plungers pause when they reach the limit of the stroke, so that the action is smooth and without shock.



A NOVEL LAG SCREW WRENCH.



THE DEAN STEAM PUMP.



THE MORRIS INSULATED PULLEY FOR LAMPS.

The Morris Insulated Suspension Pulley.

In order to avoid leaks and grounds caused by metallic pulleys as usually employed in connection with arc lamp suspensions, Mr. Elmer P. Morris, of the Novelty Electrical Supply Company of Cincinnati, O., has invented a special form of insulated pulley which is shown in the accompanying illustration. The pulley is insulated from the casing as well as from the suspension wire by means of insulating bushings, so that grounds and leaks are prevented, no matter whether the pulley is fastened to an iron post or otherwise. It will also be noted that the method of suspension keeps the pulley in a horizontal position. An additional feature allows the lamp-rope to be passed out over and above the bushing supporting the suspending wire; thus, if the spindle of the pulley should break, the lamp would not fall to the ground but still be supported by the bushing. The pulley is encased in iron to prevent the sleet from reaching it.

Mr. Morris has also designed a number of other specialties for electric light line work, one of which is a new form of

insulated arc lamp hanger which can be readily attached to any of the ordinary cross bars supporting the lamp hoods. It is neat and substantial in form, consisting merely of a heavy porcelain insulator supported by two frames of wrought iron, which are clamped to the cross bar by four bolts.

The Novelty Electrical Supply Company have also brought out a number of useful electric railway line construction devices. Among these is the Morris pole top or insulated combination pole attachment. This top is made of cast iron, and consists of but a single piece of metal. It is about 20 inches long, and has two lateral prongs or arms, in which are placed insulators designed for holding feeders for the main currents, and is well insulated when

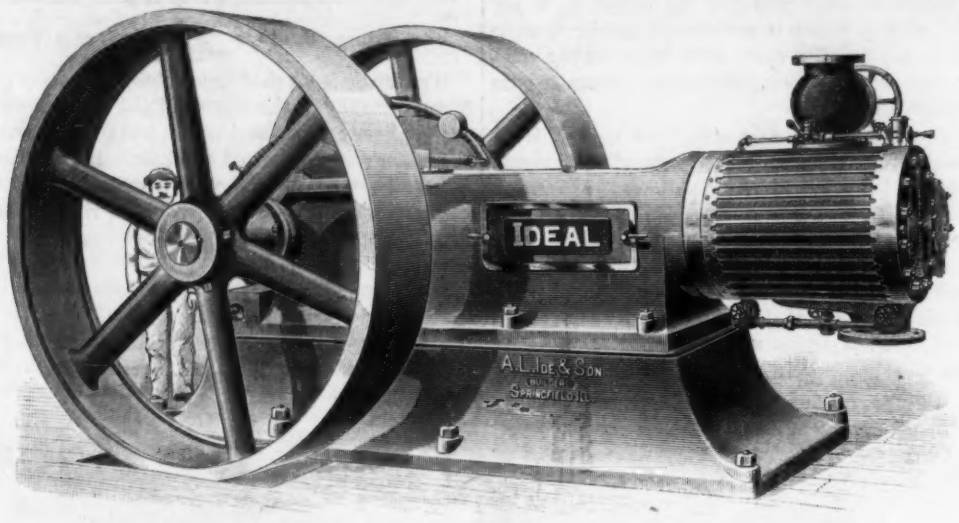


FIG. 1.—THE NEW "IDEAL" ENGINE FOR LIGHT AND POWER.

placed on the top of the poles. In the present pole tops, the guard wires are not over five inches above the span wire—that is, the wire suspended from pole to pole on each side of the track and from which the trolley line is suspended. The new attachment allows the guard wire to be fully a foot above the span wire, thus avoiding the danger of the two wires coming in contact in case the upper one should sag down or something should drop on it. The device for holding the extremities of the span wires is simple and safe, as it is made upon the principle of a screw bolt, which allows the tension to be easily regulated at will by the use of a wrench.

The arms for holding the feeders are quite novel, and project several inches from the main body of the pole, thus allowing the two currents, positive and negative, to be separated a foot or more.

Special "Ideal" Engines for Electric Lighting and Power.

We illustrate herewith a special "Ideal" engine manufactured by A. L. Ide & Son, Springfield, Ill., who have designed this engine especially for electric railway and central electric lighting and power station service. The cuts were made from photographs of two engines recently placed in the Chicago Edison Company's station for generating 2,500 16 c. p. lights each. The engines are rated at 200 h. p., the cylinders being 18¼ inches diameter by 18 inches stroke, running at 200 revolutions per minute.

Owing to the large bearing surfaces, great strength of parts, and the continuous flow of oil over all bearing surfaces (as illustrated in our issue of Dec. 29, 1888), these engines are enabled to operate under the maximum load with 125 pounds steam pressure for a great length of time without heating of parts or requiring any adjustment of the bearings.

Messrs. Ide & Sons manufacture this special engine in sizes from 100 h. p. to 250 h. p., and have recently placed a large number of them in service for operating electric street railways, for which service it is claimed they are especially adapted on account of their heavy design and perfect regulation. As our readers are probably aware, the requirements of electric railway work, as to engines, are very exacting, and no engine but the best has any chance of favor or success. Sixteen of these engines are being placed in the new electric light plants being built by the city of Chicago for street lighting.

The New Term, "Ward."

A term has long been needed, says the London *Electrician*, to denote direction along a line, as is so frequently needed in speaking of electric currents, magnetic forces, and many other physical quantities. Such a term has now been coined by the same accomplished hand to which we owe the useful words "torque," "dyne," and "numeric"—Prof. James Thomson, of Glasgow. The new word is "*ward*," a substantive noun signifying "line and direction in a line; that which is represented ordinarily by a barbed arrow." Sir William Thomson, writing in the *Philosophical Magazine*, uses his brother's term as follows: "I now define the ward of magnetization as the ward in which the magnetizing force urges a portion of the ideal northern magnetic matter or northern polarity."

An Electrical Apparatus for Determining Melting Points.

The exact determination of the fusing point of oily substances, such as certain kinds of wax, is very difficult, owing to the fact that they pass through an intermediate viscous stage. An electrical apparatus for this purpose has been devised by M. Ferdinand Jean, manager of the Paris Bourse de Commerce, and it was exhibited by him at the recent International Congress of Chemists. The apparatus consists of a U-shaped tube, spread out at one end to receive a sample of the substance to be tested, which is covered with a layer of mercury. Two platinum wires, forming part of an electric-bell circuit, are introduced into each half of the tube, and the tube is then placed in a water bath. When the substance attains its melting temperature it flows into the lower portion of the tube, and the mercury completes the electric-bell circuit. The temperature shown by the thermometer in the bath at the moment the bell rings is taken as the melting point of the substance.

Duplex Telephony.

To the Editors of The Electrical World:

I have read with much pleasure Mr. J. A. Barrett's well written, timely and instructive article on duplex telephony, in the issue of the World dated January 18. As, however, Mr, Barrett is not very sanguine with regard to the early adoption of this system in America, and as the reasons he gives do not appear to be above criticism, I will, with your permission, make some comments thereon.

1. He cites the patent of F. Jacob as being a bar to the adoption of the duplex system in America. I cannot agree with him in regard to the scope of this patent. But even if said patent is as comprehensive as Mr. Barrett seems to suppose, the question is purely a financial one, which it would doubtless be easy to arrange. The parties controlling the patent surely do not hold it for the sole purpose of blocking the introduction of a duplex telephone system in the United States. At the best, Jacob's invention would be of no more service in practical telephony than would be the use of the telephone receiver without the microphone transmitter.

2. Mr. Barrett seems to fear retardation of the telephone current from the use of the duplex coils. This fear is altogether groundless. He has evidently overlooked two important features in our duplex system, viz.: (a) In using the doubly wound trunk-line instruments the electrical impulses move only in the metallic circuit, and are unaffected in any way by the coils in the branch lines; that is, the coils in the two branch lines, being completely outside of the metallic circuit, retardation by the coils is impossible. (b) It is true that when electrical impulses are generated in the grounded circuit, the coils of the doubly-wound metallic circuit instrument may be in circuit at the same time, but these coils being differentially wound with reference to the grounded circuit, the retardation is limited wholly to the number of ohms of resistance in the wire making up said coils; there can be no retardation from self-induction. Moreover, as the coils and the two branches of the metallic circuit are connected in parallel, the total resistance of the grounded circuit is only one-half that of a single line and only one-quarter that of the metallic circuit.

3. Mr. Barrett fears increased induction from parallel circuits. This is a question that must be decided by actual experience. I am at a loss to understand why it should be so.

4. Mr. Barrett also claims that duplex telephony will involve the adoption of a more complicated switchboard arrangement. Switchboards for the metallic circuit system are now in use, and I do not see that the duplex system will involve anything more complicated than that metallic circuit switchboard. However this may be, the inventive genius of a Barrett or a Carty will surely be equal to the occasion.

I have great confidence in Mr. J. A. Barrett as a practical electrician, and I believe he has had some experience in duplex telephony; but, in penning the article referred to, he has evidently made his prognostications largely on theoretical grounds, and, if I may be permitted to venture a professional opinion, I would diagnose the case as follows, viz.: "Written during an attack of indigestion."

It may perhaps not be out of place for me to mention in this connection, that in April last I had some conversation with Mr. T. D. Lockwood, of the American Bell Telephone Company, and I found that he was much more sanguine with regard to the duplexing of telephone lines than our friend Mr. Barrett appears to be. A. M. Rosebrugh, M. D.

Toronto, Jan. 20, 1890.

The Converter Tests at the Massachusetts Institute of Technology.

To the Editors of The Electrical World:

I am very much astonished to read in The Electrical World for Jan. 18 an account of certain tests of converters, purporting to have been made under my direction at the Massachusetts Institute of Technology. Partly on account of what it inserts and partly on account of what it omits, the article in question is so misleading that in justice to myself I feel obliged to state that the results referred to are given entirely without my authority, and that their publication appears to me to involve a breach of confidence on the part of some one—I do not know who. I am quite unacquainted with the gentleman whose name is attached to the paper.

A great many tests with converters, mostly furnished by the courtesy of the electric companies, have been made by the students in our laboratory, using various methods and with various degrees of accuracy, but none of them have been sufficiently extended or complete to justify their publication. The results given in Mr. Marshall's article form a very small portion of those which have been obtained, and are entirely the work of the students, subject only to general advice and instruction from their teachers, and are, in fact, a part of an original thesis by two of them. Had the thesis been published it would have been issued under the names of the students alone, since it was so entirely their own work—work creditable to them, but subject to certain criticisms, because of which I have refrained from publishing it.

I do not wish it to be inferred from what I have said that I regard the high values obtained for the efficiency as being seriously in error. On the contrary, they probably show with approximate accuracy what figures can be obtained from a well-made converter under favorable circumstances.

The last paragraph of the article under consideration is incorrect in several particulars, besides being misleading in its tenor.

Chas. R. Cross.

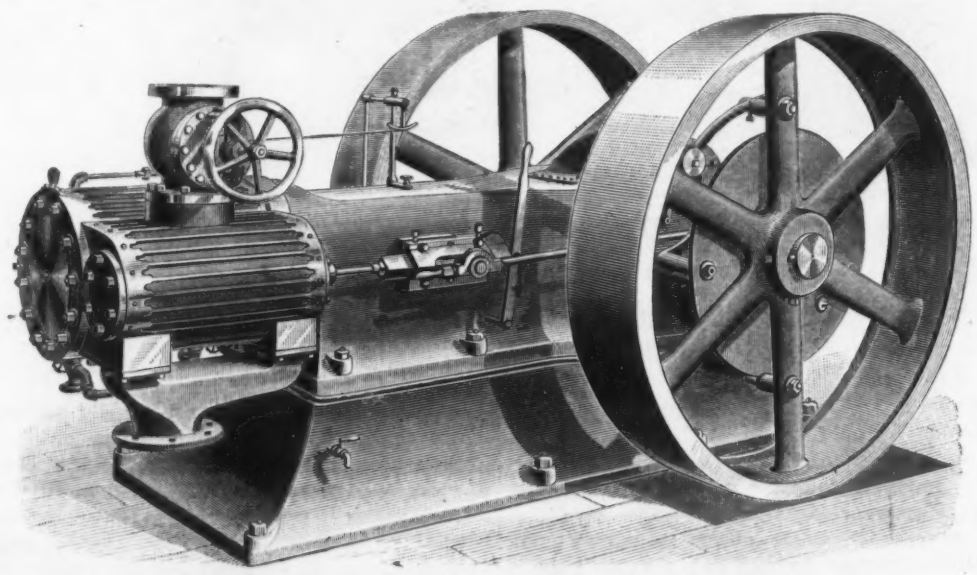


FIG. 2.—THE NEW "IDEAL" ENGINE FOR LIGHT AND POWER.

The Hercules Mining Machine and Tesla Motor.

The accompanying illustration represents the Hercules mining machine operated with the Tesla motor of the Westinghouse alternating current system. This is the first application made of the Tesla motor in connection with mining operations; but the fact that it has been such a signal success renders the great future for the motor even in this particular branch a certainty.

The Hercules Mining Machine was invented by Mr. E. E. Carter, a mechanical engineer of Pittsburgh, who sold it to the Hercules Mining Machine Company, a corporation composed of a number of Pittsburgh capitalists, prominent in the coal industry of the Monongahela Valley. The company at once set to work to make the machine a practical success. Experiments were inaugurated in the mines of the First Pool Monongahela Gas Coal Company, and the first problem presenting itself was to find a suitable motive power for the machine. Compressed air was utilized for some time and then abandoned to make room for electricity, which had proved to be much more practicable, and since the application of the motor to the machine nothing could be more satisfactory than the work of both.

As far as the machine itself is concerned, we may state that its dimensions are 36 × 60 inches, with an undercut of 42 inches and a scarf from 3 to 3½ inches high. In operation with the Tesla motor, it is handled by one man only. Its production represents a capacity of 600 square feet (floor space) in ten hours. Its great advantages are less physical labor for the miner and an assurance of an increased profit to the operator, which gives him an opportunity of paying the miner better wages. While the machine is going the man may leave it to itself and attend to the preparations for the next shift.

The success of the experiments have prompted the Monongahela Gas Coal Company to install a large plant of

JENKINS MINING DRILL.

the machines at their mines, and the Hercules Mining Machine Company has made a contract with the Westinghouse Electric Company for a large number of Tesla motors, as the prospects are that within the near future a large number of the machines will be disposed of.

The Jenkins Combination Electric Motor and Drill.

Recognizing the great adaptability of the electric motor to mining operations of all kinds, Mr. Wm. H. Jenkins, of Denver, Col., has sought to apply it to the operation of a percussion drill, and has accomplished the object by combining with the drill an electric motor, connection between the two being effected by means of a flexible shaft. Our illustration shows the Jenkins drill, which is capable of striking 300 blows per minute, each blow equivalent to 400 pounds, and which is capable of penetrating the hardest granite at the rate of one inch per minute. The drill which is now being exhibited in operation at Denver can be erected and started, or changed from one position to an "upper" or straight "down," or any of the angles between the up and down holes, in less than five minutes, by two miners. It can drill a hole 25 inches deep in a space of only 27 inches, in a line with the hole drilled. The weight of the drill and column complete is 200 pounds.

Storey Electric Locomotive for Metal Mines.

This mining locomotive is now being manufactured by the Sprague Electric Railway and Motor Company, from designs made by Mr. I. E. Storey. One of the noticeable advances made in modern mining science is the adoption of electricity as a medium for transmitting power and producing light, and such applications indicate the growing demand of mining companies for just such apparatus, and the ability of the leading electric companies to supply the need.

In our issue of Jan. 4 we described and illustrated a variety of electric mining apparatus manufactured by the Sprague Electric Railway and Motor Company, and which have met with a marked degree of success wherever they have been installed. In this issue we show a new type of electric locomotive for metal mines, which is now being manufactured by the Sprague Company, and which is specially designed to operate on narrow gauges. This locomotive is simple, powerful and compact, and is built with special reference to the arduous duties required of such a machine.

The gauge of the locomotive illustrated is 18 inches, but it can be accommodated to any gauge in ordinary commercial work. In order to protect the machine from damage, all the working parts are completely boxed in, as shown.

The speed of the motor is under complete control, by means of a switch, which throws the winding of the field into different electrical combinations, thus varying the speed of the motor without the use of any wasteful resistance. The direction of rotation is also governed by the same switch, so that the operation of the motor is very simple, and can be put in charge of an ordinary workman.

Any system of conveying the current from the dynamo to the locomotive can be used, employing either the rails as one side of the circuit for the return of the current, or else a complete metallic circuit by the use of a double overhead trolley wire. In this latter case, a trolley pole, shown in the engraving, and carrying at its upper end two trolley wheels for making running contact with the overhead wires, is attached on the rear of the locomotive car.

The Michigan Electric Light Association.

A meeting of the companies doing business in the State of Michigan was held at the office of the Brush Electric Light Company, Detroit, Jan. 17, for the purpose of organizing a State association. The attendance and the response from companies throughout the State was good. The desirability of organizing such an association was agreed to without dissent.

The association organized by adopting by-laws and electing the following officers:

President, Geo. Peck, president Edison Illuminating Company, Detroit; vice-president, James R. Dee, general manager Peninsular Electric Light and Power Company, of Houghton and Hancock; secretary and treasurer, Jos. E. Lockwood, general manager, Brush Electric Light Company, Detroit. Executive committee: George Peck, Detroit; James R. Dee, Houghton; Jos. E. Lockwood, Detroit; W. H. Powers, Grand Rapids. One vacancy was left to be filled after the filing of membership applications. The secretary was directed to send a copy of the by-laws and a blank application for membership to every company in the State. The association will give its first attention to the establishing of a general system of rules and regulations for the wiring of buildings, so as to secure the safest and best construction and service.

Brightening of Incandescent Lamps on Switching Off.

To the Editors of The Electrical World:

What is the cause for the momentary brightening of an incandescent lamp after the lamp has been switched off and before the filament has become cold? This is with an alternating current; I do not know whether the same is true with a continuous current. WILL S. HAYS.

AUSTIN, Tex.

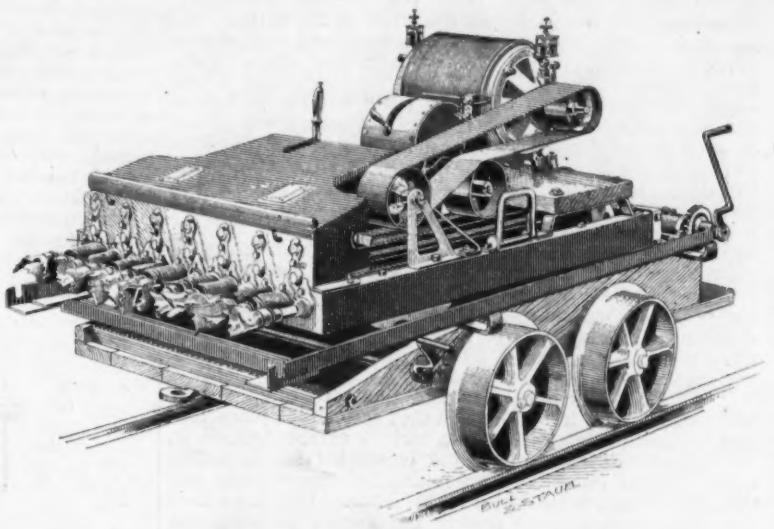
ANSWER.—The phenomenon noted by our correspondent has never been brought to our attention before, and if it be an established fact, we can at present assign no definite reason for it. It seems to partake in its nature of the recalescence in iron and steel noted by Hopkinson and Thomson, though this property has not, so far as we are aware, been noted in carbon. It may probably be due to local causes, such as a false contact in the switch. We should be glad to hear from others of our readers who may have observed the phenomenon.—EDS. E. W.

Power of Water Wheels.

To the Editors of The Electrical World:

As a reader of your valuable paper, and interested in its reliability, allow me to call your attention to a statement concerning the "Pelton Water Wheel," appearing in the January 4 number of THE ELECTRICAL WORLD. The article in question gives the head of water at 1,630 feet, velocity of issue from nozzle 19,260 feet per minute, and states that a wheel is capable of developing 125 h. p. with a stream half an inch in diameter.

The actual power in the water used under these conditions is found by multiplying together the head, the velocity, the area of nozzle reduced to square feet, the weight of a cubic foot of water, say 62.5 pounds, and dividing this product by 33,000, or, $\frac{1{,}630 \times 19{,}260 \times 62.5}{5 \times 144 \times 33{,}000}$, which equals 82.58 h. p.



HERCULES DRILL AND TESLA MOTOR.

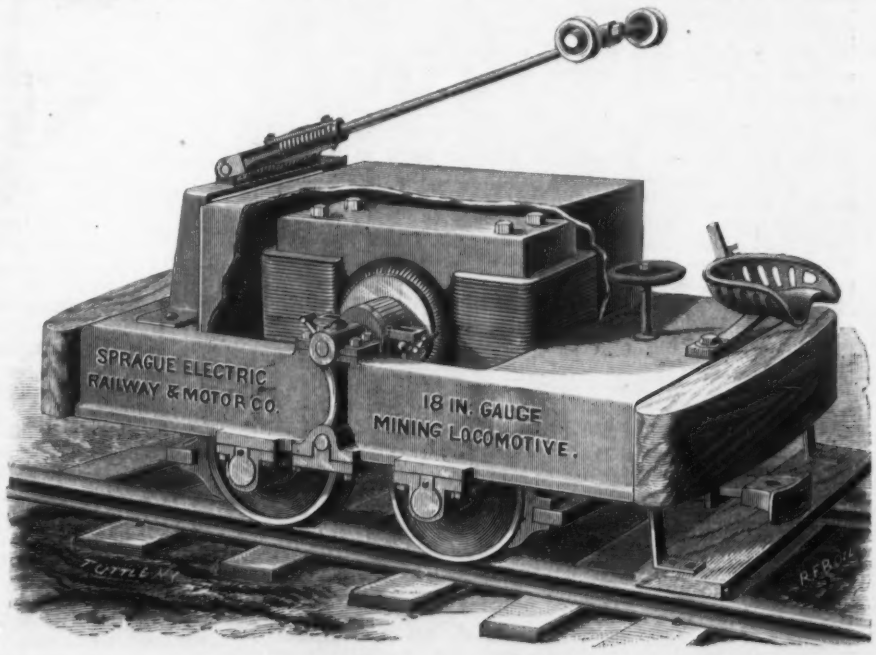
According to this, the wheel is developing 50 per cent. more power than there is in the water used. I suppose the printer made some mistake in setting up the above data, as the manufacturer would hardly dare to make such a claim. F. H. WILLIAMS.

DUBUQUE, Ia.

ANSWER.—Our correspondent's calculations are correct. The error is probably due to a misstatement in the size of the nozzle. By taking the latter as equal to ⅝ inch, instead of ½ inch, the result obtained will be approximately 125 h. p., as stated in the article.—EDS. E. W.

The Electrolysis of Cryolite.

In a paper on "Electrolysis of Cryolite," in the *Journal* of the Chemical Society, Mr. W. Hampe says: "By the electrolysis of cryolite, or mixtures of cryolite and sodium chloride, some investigators have obtained aluminium bronze, others have not; the success of the former is due to the use of a solid copper negative electrode, and the failure of the latter to the use of molten copper for that purpose. The author's experiments indicate that when the electrolysis takes place near the melting point of copper, bubbles of sodium vapor come off and burn at the surface; any aluminium set free is in such a finely divided state that it almost all combines with the fused cryolite to form the subfluoride; but when the electrolysis is conducted at lower temperatures, the sodium separates in a liquid state and gives rise to larger aggregations of aluminium, which consequently expose a smaller proportion of surface, and are less rapidly attacked by the molten cryolite; nevertheless, some is attacked, and the yield of aluminium alloyed with the copper is always much below theory. The alloy has a lower melting point than copper, and therefore melts off the electrode and drops to the bottom of the crucible. By mixing salt with the cryolite, the melting point of the latter is lowered, and the electrolysis may be conducted at a lower temperature.



STOREY MINING LOCOMOTIVE.

A Review of Modern Electrical Theories.*

BY PROF. WM. A. ANTHONY.

The general phenomena of electricity are familiar to us all. As children we learned of the attraction and repulsion of electrostatic charges, of condensers, of insulators and conductors, of electric currents and electro-magnets, of telegraphs, of electric fire alarms and electric bells, of the heating of conductors, and even electric lights. We have long been familiar with the effect of the current on a magnetic needle, and with the attraction and repulsion of currents for each other. We have seen that these effects are manifested at a distance from the conductors which carry the currents, and we have been willing to believe that the distances at which these phenomena could be recognized were limited only by the want of sensitiveness of the apparatus through which the effects were manifested. Probably not many of us stopped to think *how* these effects were brought about. We were content with a general statement of the relations of the phenomena, or, at least, with the determination of the direction and intensity of the forces due to a given conformation of current. We talked of the attractions and repulsions as action across space, and, if we thought of them at all as requiring any mechanism through which to act, we still felt satisfied when we had discovered and formulated the laws that govern the action of these forces.

It did not matter to us that attraction across empty space was unthinkable; it was enough that action took place, and that we could measure and, to a certain extent, control it. We constructed instruments and computed forces acting under certain conditions; we multiplied experiments and thought we had developed a vast science. But there have not been wanting, even among the earlier philosophers, some who could not feel satisfied with the idea of action at a distance. Experience gives no clue to any explanation of action of one body upon another at a distance, except through some intervening mechanism, and if we find cases where such intervening mechanism is not apparent, to say that in these cases action at a distance is taking place is only to say that the action is unexplained.

Gravity acts upon the distant planets, and, we believe, upon the most distant stars; but it is not enough to say that gravity acts, that it decreases as the square of the distance increases; we want to know *how* it acts. By what means, or through what medium, does our earth reach out to the distant planets and affect their movements? These are the questions that the dissatisfied few have asked in the past, and to-day it is not the few but the many who would be glad to have the question answered. Faraday early taught us that the mere statement of the law of electrical attraction or repulsion was no explanation, and he sought the explanation in the action in the intervening medium. He demonstrated, by experiments that have become classic, that the effect of induction depends upon the nature of the medium intervening between the conductors; a demonstration that here, at least, the intervening medium took part in the action and helped to determine the result. Magnetic and electro-magnetic phenomena were to Faraday also effects propagated through the medium; and Maxwell, following Faraday's work, subjected the whole matter to a searching mathematical analysis. It was necessary, in order to complete the theory, to assume the existence of a medium in which the forces were exerted; but, as a medium had already been assumed to account for the phenomena of light, it would hardly be scientific to assume another to account for electrical phenomena. But would not one medium suffice for electrical and optical phenomena as well? Maxwell showed how the question of the identity of the two media could be tested, and our modern views of electricity are mainly the results of his work. What do we *know* of electrical phenomena? We know that pieces of glass and silk rubbed together and then separated attract each other; that the property of attraction can be imparted to metals if they are insulated; that if two such masses of metal be connected by a wire the power of attracting each other disappears, and, at the same time, the wire is warmed and for an instant exerts magnetic forces at right angles with the wire. Numerous other facts we know, but these will suffice as illustrations of the phenomena. When a metal conductor is discharged by touching it with a wire we say the wire carries a current, and we have been accustomed to ascribe the heating and the magnetic effects to that current. We have looked upon the thing, whatever it is, that takes place in the wire as the origin of all that takes place around it. The current warms the wire, and it confers upon it the property of acting upon magnetic needles; but *how* does it act? We cannot conceive of the action of that wire on that needle, except through something extending from the wire to the needle through which the wire can exert a push or pull. All around that wire the needle is affected; at considerable distances the effect can be exhibited, and we believe it is only want of delicacy of our apparatus that prevents our discovering it at the greatest distances. If the wire acts it acts through a medium in which it creates a disturbance, and the disturbance in turn acts upon the magnetic needle. But are we sure that the action begins with the wire? Is it not possible that the action begins in the medium, and that the wire merely separates portions of the medium and so permits action that could not otherwise take place? Maxwell has proposed a mechanical illustration of the action taking place in space when electrical phenomena occur, and Fleming and Lodge have elaborated it and brought it within the reach of non-mathematical readers. Let us suppose all space to be filled with wheels connected by idle wheels in such a way that when one turns all must turn in the same direction, except that the elasticity of the system permits a small movement of one wheel before the others in the vicinity begin to move. Electromotive force is then something that tends to turn the wheels. Let *b* in Fig. 1 represent some source of electromotive force; *a* and *c* conductors not forming a closed circuit but having an opening at *d*. The electromotive force at *b* tends to turn the wheels, but so long as the gap exists at *d* the wheels are connected through all space, and the E. M. F. at *b* can effect nothing except to turn the wheels through a small angle until the elastic resistance balances the E. M. F. In the conductor the wheels are not supposed to be rigidly connected. They can turn by slipping on each other, and the wheels in space may turn by slipping on the wheels in the conductor; hence, as the ends of *a* and *c* approach each other, the connection between the wheels within the inclosure and those of outside space becomes smaller and smaller, and, when the conductors touch, there is no longer anything to prevent the wheels within from turning, and they begin to spin in obedience to the E. M. F. at *b*. The conductor is heated by the friction due to the slip of the wheels around and within it. The spinning of the wheels constitutes the magnetic forces if we assume the wheels, originally spherical, to become flattened spheroids by the spinning, and to be forced to remain in contact at their poles. Assume the wheels to have inertia, and it will require time for them to reach their full velocity, and the time will be greater as the number of wheels is greater, that is, as the magnetic forces developed are greater. On the other hand, the wheels will not at once stop if the electromotive force is removed, and if the conductor be broken at some point, allowing the rapidly spinning wheels inclosed by it to come in gear at that point with the stationary outside wheels, there will be, for a brief time, until the moving wheels can be brought to rest, a clashing and disruptive action known as the extra spark.

I have spoken of the heating of the conductor as due simply to the friction of the spinning wheels upon the

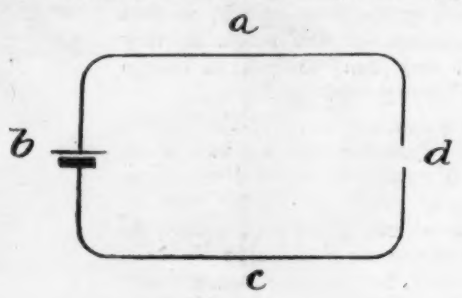


FIG. 1.

wheels within the conductor. The greater the friction the greater the motion imparted to the wheels within the conductors and the greater the heating. The less the friction the less the heat, and if there were a substance whose wheels could revolve among themselves and against the wheels of space without friction, such substance would form a perfect conductor which would offer no resistance to the motion of the wheels in the space inclosed by it; and however rapidly those wheels might revolve they would have no influence to produce motion within such a conductor. We are led, then, to this, that a perfect conductor, instead of being a substance in which any F. M. F. produces an infinite flow of electricity, may be a substance in which no effect whatever is produced.

I do not present this as representing the real activities involved in electrical phenomena, or as a theory by which all electrical phenomena may be explained. I give it as bringing prominently into view the activities in the medium surrounding the conductor; whereas, the language in which we usually describe electrical phenomena points to the conductor itself as the seat of the electrical forces. Whatever our theory, we know that something does take place in the medium that surrounds the conductor. We know that were a heavy current to flow through a conductor in the most distant part of this room, a delicate needle here on the table would show that a magnetic field was produced here. We are certain that magnetic lines of force from the electric currents on our streets, whether overhead or underground, permeate this room, and traverse our bodies even, though we have no sense through which we can become directly conscious of them. Take in your hands two wires connected to the poles of a battery or dynamo and touch their ends together. You see a flash of light, the wires become warm, they attract iron filings; coiled into a spiral they will attract with great force large masses of iron; two such spirals will attract or repel one another. What more natural than to say, Here in the wire is a new activity which warms it and confers upon it magnetic properties? What more natural than to forget or fail altogether to recognize the activities in the space around; activities that do not impress any of our senses; that do not wrench our arms, or burn our flesh, or blind our eyes; and yet it is well to fix our attention for a while upon the space that the conductor incloses, and recognize the fact which the little delicate needle demonstrates to us, that something is going on in that space, something quite

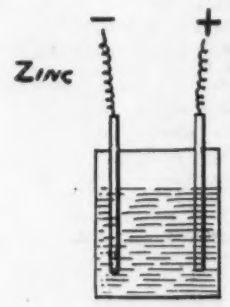


FIG. 2.

as important, perhaps more important, than that which takes place in the conductor.

Whatever the magnetic forces are, we know they cannot be called into existance instantaneously. Time must always elapse before the full effect of an electric current is felt, and the greater the forces developed the longer are they in reaching the maximum. Moreover, the current in the wire cannot be at once developed; it keeps pace with the magnetic force, and reaches a maximum only when the magnetic forces reach a maximum. This is exactly what would follow if magnetic forces result from the setting in motion of wheels possessing inertia. Whatever magnetic forces may be, they begin and end like the motions of massive bodies.

Continuing our hypothesis, an electromotive force would be anything that tends to set the wheels in motion. The wheels are set in motion if a limited number acted upon by the E. M. F. are separated by a conductor from the other wheels of space; but even if they are not separated, that is, if the conductor does not form a closed circuit, the wheels are rotated through a small angle depending on the elasticity of the wheel work. This displacement constitutes an electric charge, the tendency of the wheel work to spring back is *difference of potential*, and this difference of potential is maintained by the E. M. F. Here allow me to call attention to the distinction between difference of potential and E. M. F. I often see statements that indicate that the distinction is not clearly kept in view. In that excellent little volume, the Dictionary of Electrical Terms, the statement occurs that electromotive force is *due to* difference of potential. It should rather be difference of potential is due to E. M. F. Difference of potential is *an* electromotive force, but not all electromotive forces are difference of potential; and, furthermore, I can think of no case of difference of potential that does not owe its existence to some other electromotive force, not difference of potential. Difference of potential is a moving force acting from within. Electromotive force acts from without. Difference of potential results from a changed electrical distribution, an electric strain, and represents the tendency to return to the state of equilibrium. Electromotive force is the something from without that produced the electric strain. Consider our wheelwork illustration. I may seize a wheel here and turn it, but I can only turn it through a small angle beforce the elastic forces, brought into play by the distortion, balance the force that I am able to exert. My force is electromotive force; the elastic forces are difference of potential. Let Fig. 2 represent a voltaic cell with its copper and zinc plates and dilute acid; we know that something takes place by which the copper becomes positive and the zinc negative, and, if the copper and zinc be joined by a wire, electricity is said to flow from the copper to the zinc through the wire, and from zinc to copper through the liquid. The flow through the liquid used to be explained by assuming the zinc to be positive and the copper negative within the liquid; just the reverse of what we find without. But connect the copper to the zinc by a wire under the liquid, the current flows through the wire from the copper to the zinc. The copper, therefore, is not negative, but everywhere positive. Then why does the current set from the zinc to the copper through the liquid? Because there is an electromotive force, not difference of potential, mind you, for the difference of potential tends to cause a flow the other way, but a something that forces the current through the liquid against the electric pressure. The cell is an electric pump that pumps electricity from the zinc into the copper until the pressure becomes so great that the pump stops. Open a passage from the copper to the zince by connecting the two by means of a metallic wire, the electricity flows and relieves the pressure, the pump begins to work and so maintains a continuous flow. No; E. M. F. is not difference of potential, although difference of potential is E. M. F. It is even possible to produce an electric current without any difference of potential whatever in any part of the circuit, just as it is possible to produce a flow of fluid without any difference of pressure.

Whatever difference of potential may be, it behaves like a force developed by an elastic displacement in a solid body. Whatever magnetic forces may be, they behave as though produced by the motions of inert masses. An electromotive force, suddenly brought to bear at a given point, has to overcome not only the elastic force, but the magnetic inertia. In other words, an electromotive force, tending to produce current, immediately develops a difference of potential against which it must act, and also develops magnetic forces which retard its action; so a *fluid-moving force* meets opposition in the elastic force of the fluid and in the inertia of its particles. But the effect of any such force is propagated through the medium with a definite velocity expressed by the well-known formula,

$$V = \sqrt{\frac{E}{D}}.$$

Electric displacements ought, therefore, to be propagated with a finite velocity which should have some relation to the ratio between the electrostatic effects, analogous to elastic displacements, and the electro-magnetic effects analogous to the effects of moving masses. You all know that it is shown that this velocity is expressed by the ratio of the magnitudes of the electro-magnetic and electrostatic units quantity, and you know also that determinations of this ratio show it to be the velocity of light. This determination gave a very strong support to Maxwell's electro-magnetic theory of light, and coupled with the fact that observations, so far as they went, indicated that magnetic effects are propagated from the sun to the earth with the same velocity as light, made the theory at least extremely plausible. But within two years the wonderful experiments of Hertz have demonstrated beyond question that electro-magnetic waves travel through space from every source of alternating currents or potentials, and that the waves travel with the velocity of light. In this city there are, I suppose, many alternating current systems. When we think of these in action we are apt to think only of the activity in the conductors of the machines, the lines, the transformers, the lamps, and yet we know that in all the space around there is activity. Waves are chasing each other through this room, through our streets, our houses, our offices. They are everywhere present. We are bathed in this agitated medium every moment, and yet we live, and not only live, but are totally unconscious of the activity that surrounds us. No sense responds to the wave motion that fills this space. And yet, when these waves become short enough and frequent enough, they do affect our sense of vision, and a vast array of phenomena that otherwise would have had no existence for us are made known to us through this special sense. But the eye only responds to waves of $\frac{1}{76000}$ to $\frac{1}{37000}$ of an inch in length, while the length of the waves emitted by one of our alternating current systems is 600 miles. The waves that affect the eye must occur at the inconceivable rate of at least 400 millions of millions per second, while less than 300 waves per second are emitted from our alternating systems. These waves come very far short of the number necessary to affect any of our senses, but we have been able to demonstrate their existence, at least we have been able to show that something possessing all the characteristics of wave motion exists in the space around a source of alternating currents or potentials. It is something to know that waves of such enormously different lengths and frequencies exist in the medium that is agitated by waves of light. It is something to understand that our sources of alternating currents are centres of radiant energy, differing from light only in wave length; and since we have begun to appreciate this fact, we have often asked ourselves the question, Can the rate of alternation be increased until the whole apparatus should glow with light? Although the enormous rapidity required seems to render this direct solution impossible, it seems to me there must be a way to obtain the light we want without all this waste of energy. I cannot believe it will always be necessary to develop waves of all lengths, from many miles down to a hundred thousandth of an inch, in order to obtain the narrow range

* Read before the American Institute of Electrical Engineers, New York, Jan. 21, 1890.

of wave lengths by which we see. I do not know of any practical way of obtaining the few wave lengths that constitute light without at the same time producing the others, but it *is* done. The glow-worms do it, the fire-flies do it, the lantern beetles do it, and I believe the time is coming when man can do it. Instead of getting 10 sixteen-candle lamps per horse power we ought to get 200. I don't know how it is to be done. I don't expect we are going to make alternating machines to produce 500 millions of millions of alternations per second. But possibly we may solve the problem indirectly by the use of some substance having a special rate of vibration, such as the gases. Possibly we may be able to excite electrically the fluorescent salts. Possibly we may be able to charge and discharge a condenser and take advantage of the oscillatory discharge to set up vibrations of the frequency required. Possibly we may discover the secret of the glow-worm and fire-fly and substitute electric for the insect energy. I know it will take several fire-flies to equal a 16-candle lamp, but it will also take a good many fire-flies to develop a horse power. But although I do not see at present any practical solution of the problem, I repeat, I believe the problem can and will be solved. We are not going on forever burning a coal mine whenever we want a little light. Neither are we going on forever converting the energy of coal into heat when it is mechanical or electrical energy we want. From the very nature of things not more than one-fourth or one-third the heat so produced can be transformed into any other form of energy. The energy of fuel *can* be converted into mechanical energy without first becoming heat. It is so converted in every animal movement. The way exists; let us find it. Find this, and the way to make light only, when it is only light we want, and we shall have lengthened the life of our coal deposits five or ten times. The man who solves either one of these problems will be the greatest discoverer of this or any other age. If he gets a broad patent on it, he will have seventeen years of the grandest litigation the world ever saw.

Now I can imagine that some electrician will consider that the first part of this paper dealt with matters that are of no practical consequence in the use of electric currents. Of what practical consequence is it whether force is conveyed to a distance by means of a medium or simply acts at a distance. What does it matter whether electric energy is conveyed by the conductor or through the dielectric? We know how to proportion and dispose our conductors to produce a given effect, and that is enough. But consider what we have learned already of the intimate connection between light and electricity, and I think you will agree that the more we know of the ultimate nature of electricity the nearer we shall be to the solution of the great problem to which I have referred, and the solution of either one of those problems would revolutionize some of the most important industries of the world. May not the solution of at least one of these problems be accomplished, and the results exhibited at the great exhibition to be held in New York in 1892? What a wonderful achievement it would be to light all those great buildings without heat, or drive all that vast array of machinery without a fire!

A Practical Storage Battery.

BY J. K. PUMPELLY.

"Eighty years ago Ritter constructed a secondary pile and obtained from it a reversed current of short duration. Since that time many eminent scientific men have investigated the subject of voltaic polarization, but it was the invention of the powerful cells of Plantè and the perception of how valuable an addition to the resources of electrical engineers a good secondary battery would be that raised the subject to one of practical importance."

The above is quoted from Gladstone and Tribe in the introduction to their little work on the 'Chemistry of the Secondary Batteries of Plantè and Faure,' and will give the general reader some idea of the importance of the discovery to this age of practical work, and of the possibilities of improvement in the secondary battery itself. Indeed both scientists and laymen are all agog regarding this matter, and although the practical and advanced engineer is looking on with great and even anxious interest, he especially, with pencil and note book in hand, is jotting down figures of results which can only give the sum total of cost, and answer the great and momentous question of to-day, "Will it pay?" and still another, "How much will it pay?"

In many circumstances and in many places, in electrical work, the storage battery has become a necessity. Here it pays surely, and the only question is, which is the best for the work; but when the work demanded of the battery depends on much more than its mere temporary efficiency, then the question is an anxious one, and a favorable answer of vital importance. Let us see what some of these questions may be, and why the engineer of some street railway shakes his head over the results of expensive experiments lasting for months. His note-book may show many favorable figures on which to found an economical estimate of the cost of performing a certain amount of work—work satisfactorily done, undoubtedly; plenty of horse-power obtained; all the speed needed, and easily controlled, and the batteries, by the aid of a system, easily handled. Now, why, at the end of a two months', or perhaps a two weeks', trial on a railway, does he shake his head in disappointment? This is what he says: "Want of durability—a want represented by a big 'L' for loss, and large numerals for percentage of cost for renewals."

One more important discovery he makes, and notes down, namely, loss of power in the battery, caused by the jarring and shaking while passing over the rails. At last, after many trials, and much money expended, he closes his note-book with this remark: "Storage batteries are admirable for traction work on street railways, could they be made to last, could the material from which they obtain their efficiency be held together long enough to reduce the cost of renewal, so that the service obtained from them could be made to pay for the original outlay."

The reason for this loss, which stares every practical engineer in the face, pictured in such immense figures, as, for instance, 16 per cent. (cost of renewals of battery) lies in the construction of the battery. All the batteries, except one, are made up in the same way, and constructed with the object of obtaining the greatest chemical efficiency; thus durability of construction has necessarily been ignored, or rather, according to the philosophy of the makers, is forced out of their calculations. They say, We must take the chances on lasting durability under certain work, and gain efficiency, at least; but the engineers say, Economical efficiency cannot be produced for our work without durability.

A battery, excepted from this category, as noted above, and which is built on a plan intrinsically different from all the others, is that of the writer, now well established, and showing, after a year and six months of use, improved rather than reduced efficiency, which ought in reality to be the result in the long use of a storage battery, if the chemical theory is a true one.

The plates of the cells are placed horizontally one over another, but separated from one another, that is, the positive from the negative, by fibrous material, made for the purpose. This material is very absorbent, and is inert as to the electrical current, and in no way disintegrates by the action of the acid, or even the free oxygen developed in the battery, and is firm enough in its texture to support the plates when they become very active and very soft and spongy, and which, if left to be supported or held together by mere molecular cohesion, would fall apart by their own weight. Nor does this inert porous fibre increase the internal resistance in the battery, as has heretofore been taken for granted by storage battery builders.

The use of the Pumpelly battery on the St. Paul Railroad for lighting, for many months, nearly a year now, shows that the question is nearly solved, for although they have been placed on the roughest part of the road, the manufacturers have never been called upon to renew a single plate. The batteries of fifty cells, sent to the Pullman Car Company for use in car traction work, were used and tried in many very severe tests. These batteries were taken apart and examined after this severe use by Mr. Hoffman, electrician for the Pullman Company, at the factory, and much to his surprise, were found in perfect condition. These and other batteries are still in use there.

In house lighting and town lighting, these batteries seem to bear rough usage and careless handling, as far as can be judged by carefully collected reports.

The North American Phonograph Company has adopted this battery and recommend it to all branch companies, not probably because it is so much more powerful than others, but because its durability is known and its efficiency is all that is asked of it. One cell of a convenient weight, which could be handled by a man or boy, runs a phonograph for 100 hours with one charge of ten hours' duration and a three-ampère current.

An Electrical View of the Chicago Auditorium.

BY F. DE L.

Typical, outwardly, of the boundless enterprise and financial solidity of her leaders, and, within, of the refined and artistic sympathies of her feminine society devotees, Chicago's Auditorium stands forth a monument to the wisdom and business capacity of its projector, Mr. Ferd. W. Peck, and his able co-laborers.

The dedication of this palace of art, of song, of hospitality and of commerce made the closing of the year memorable in Chicago. And to all of the tens of thousands who have gathered within the inner walls to admire and dream of the wonders of the Auditorium proper has the genius of originality appeared strikingly in the perfect distribution of the thousands of soft Edison lights, arranged so that every recess is as clear and bright as though the sunshine were streaming through some vast opening. Incandescent lamps glint and reflect and reappear in a thousand forms in the Mexican onyx, the marble, the mahogany, found in pillar and wainscoting and mosaic flooring—lamps that reveal the merit in those forty-five life-size figures that appear in the great painting in the proscenium arch; lamps that peep out of plaques; that droop down in clusters like ripe fruit; that intwine about pillar and post, and that shed their roseate glow on the splendid canopy formed by the high, vaulted roof, resting on graceful arches, each one a perfect ellipse and each one growing smaller and smaller as it approaches the proscenium, so as to form a trumpet-shaped interior that renders perfect the acoustic properties of the hall.

In closing his annual report to the directors of the association President Peck said: "You, gentlemen, constituting about three hundred public-spirited citizens of Chicago, have stood together to erect the most magnificent temple adapted for such grand, broad and varied purposes, which the world has ever seen. You have a right to congratulate yourselves and to be proud of your liberality and your work and its vast benefits to your city and to your country." Yet without detracting one iota of honor from all that is due to others, may not the electrical fraternity justly claim a fair share of credit for the success of at least that dream in decorative effects? For without the incandescent electric lamp would the directors ever have been justified in allowing the walls to be finished in such soft and lovely tints, or permitted such delicate tracings and such rich drapery and canary-colored plush and silk hangings, if all were to be quickly rendered lustreless by the destructive effect of gas lights? It is said that, if the leaves of 23-carat gold used in the interior decoration were laid side by side they would cover in area nearly an acre and a half, and so perfect has the work of application been done that a renewal will not be rendered necessary under ordinary circumstances for fifty years, and that the effect will grow more beautiful with age. Would all this have been possible had not the incandescent lamp been made a commercial success?

There are nearly five thousand 16 c. p. lamps required in illuminating the great hall proper. Think of the disastrous effect that the same number of gas jets would create; of the deposition of carbon soot that would have to be removed every year or two; of the effect on the rich paintings caused by the impurities in the gas, and of the discomfort and actual suffering that would be caused by the heated atmosphere. Thus it is that the electrical fraternity can claim a fair share of credit for having made possible the Auditorium as it stands in all its grandeur.

Within the building are two separate and distinct plants, furnishing light, heat and power, both being under one general management. The total dynamo capacity of the combined plants is 12,550 sixteen c. p. lamps, a number greater than is contained in any single building in the world. And not only is it the largest isolated plant in the world, but the capacity is also far greater than that of hundreds of local central lighting stations, in fact, but a dozen of the larger cities have stations of greater capacity. Probably a fair comparison is that the total capacity of all the central stations in either of the neighboring States of Indiana or Iowa, according to the statistics shown in the American Directory, does not equal that of the Auditorium plants. Again, the total number of lamps placed therein is greater than is the total number employed in all the isolated and central station plants in any one of many States.

The larger of these two plants is employed in furnishing the necessary service to the great audience hall and adjoining offices, and contains three 125 h. p. high speed, compound Williams engines (without condensers), and one 125 h. p. Ideal engine, each belted to a No. 32 110-volt Edison dynamo of a capacity of 1,400 sixteen candle power lamps respectively, and two Bullock straight line engines of 60 h. p. and 25 h. p. respectively, belted to a 720 light and a 180 light dynamo. Leather link belting is used throughout. On the great switchboard are Andrews switches having a carrying capacity of from 1,000 ampères down to 250 ampères, or less. From this board rise the mains, carrying the current for the 3,400 lights within the great audience hall proper, to the switchboard of special design that swings on hinges and heavy rollers, and which is placed in the rear of the last section of the great iron curtain that will be raised only on special occasions, when the full width of the stage is required. On the face of this board are placed nearly one hundred Andrews switches, controlling the lighting of the lamps in the various circuits.

The total depth of the stage from the footlights to rear wall is 69 feet, and from the curtain line to the rear wall 62½ feet, leaving an apron of 6½ feet. The clear width between side walls is 98 feet, giving the total available surface stage room of 6,862 square feet, an extent more than equal to the demands of the most sumptuous of practical productions. Though the total proscenium opening has a width of 75 feet, which can be utilized on special occasions, such as the holding of conventions, the curtain width will be but 47 feet.

There are on the stage proper 1,200 lamps, not including those placed in the dressing rooms, and an idea of the general distribution may be obtained from the statement that there are 150 footlights, 330 border lights in six circuits, of red, of green and of white lamp bulbs, and an untold number of lamps in the thousand-and-one other places around the stage. In the orchestra pit are 100 portable lamps attached to long cords, allowing one lamp to each seat.

Beyond the stage, but controlled therefrom, are a total of about 2,000 sixteen c. p. lamps, placed somewhat in the following order: 49 lamps droop from the flat ceiling above the gallery seats; 73 are placed in the second balcony; 78 are distributed through the first balcony; 106 on one circuit and 68 on a second circuit, that lend their rays in giving the visitor to the foyer the first glimpse of that wonderful interior; 145 lamps are tastefully displayed in 29 clusters of five each on the larger balcony rail and 72 on the smaller rail, while 110 lamps are so distributed as to reveal the rich draperies of the boxes. Above the nine stained glass panels over the parquet are placed clusters of 12 lights each; in the first proscenium arch 217 lamps are so placed as to bring out all the beauty in the allegory of "Nature's Song of Life," this number being divided into five circuits that can all be closed or opened by one switch; the second and third arches each contain about 200 lamps, and the fourth arch about 100, or a total of nearly 700 lamps in the arches. For lighting the stairways, but not controlled from the stage, 250 lamps are employed. Then there are the lamps in the ladies' parlor, the gentlemen's smoking-room and the inglenook.

Every lamp socket in the house is tagged with a number that corresponds to the number recorded on Mr. Fanning's diagram. Thus if a lamp filament burns out, the bulb is quickly replaced with a new one. If in the arches, all needed renewals can be replaced during the performance, without attracting the slightest attention, by an attendant who enters above and behind the circuit and withdraws the socket from its receptacle.

Among the special electrical and scenic effects are the various imported devices made by Hugo Bahr, of Dresden, Germany, which are excellent in many respects and show a decided advancement over anything yet placed on the American market to serve the same purpose. Yet the apparatus as a whole is somewhat unwieldy; and so Mr. J. J. Fanning, the electrical engineer in charge of the entire electrical equipment of this grand theatre, has devised a few simple and inexpensive accessories. For instance, flashes of lightning can be drawn from the face of an old rasp file, having an insulated handle with a long cord attached, by the aid of a heavy copper wire or other similar metallic object connected in circuit with the necessary resistance. The flashing that indicates the charmed circle is quickly made by the actor passing his sword around a narrow metal surface being placed on the floor, both being connected in circuit. In the Bahr apparatus the ripple of the waves of the great ocean—or other body of water—are reproduced true to nature by slowly moving three glass plates, less than one foot square, having alternate waving lines of dark color traced or grained thereon. These plates are placed within a special form of small stereopticon and the incandescent light graduated to the desired depth. The realistic lightning that attracted so much attention during the operatic season just passed is produced in somewhat the same fashion. A large wooden wheel inclosing several prepared plates having the special form of lightning, whether the socalled "chain" or "forked," etc., traced thereon, is fitted over the lense tube of the stereopticon and slowly revolved by hand, the desired effect, magnified many times over, being secured as the glass passes in front of the incandescent light. This lamp may be a special form of focusing lamp supplied with plain carbon pencils $\frac{5}{16}$ of an inch in diameter and operated by hand. One "moon" is a placque of porcelain within which is placed an incandescent bulb that receives the necessary current through the duplex conducting cord that is also utilized in causing pale Luna to slowly move upward. The fireflies are small coils having contact surfaces of carbon that emit an electric spark on the breaking of the circuit.

The application of electromotive power is confined principally to the driving of the ventilating fans and to the operation of the bellows system used in the service of the grand organ. There are employed for this service three Thomson-Houston motors of 5, 7½ and 15 h. p. respectively, three C. & C. motors of about the same power and two Eddy motors of 10 and 15 h. p. respectively. To a line of shafting driven by electric motive power are connected three large bellows, erected under the main floor of the Auditorium, and arranged so that either one or all three may be worked in unison or separately, an automatic belt shifter permitting single, double or triple action of the bellows that force the air into wind chambers from which a smooth and constant flow of air is obtained by means of regulators.

This great Roosevelt organ is said to surpass all the organs in the world in the purity and volume of tone and number of improvements, while it is the equal of other organs in size and in the number of stops. The cost is said to be about $50,000, and a summary of the number of stops, pipes and accessories used in each part is as follows, and represents all that can be done in the way of perfect organ construction at the present day:

	Stops.	Pipes.
Great organ	20	1,611
Swell organ	23	1,733
Choir organ (carillons)	17	1,210
Solo organ (chimes)	15	854
Echo organ	11	842
Stage organ	4	244
Pedal organ	19	630
Total speaking stops	109	
Couplers	10	
Mechanical accessories	13	
Adjustable combination pistons	25	
Pedal movements	20	
Total	177	
Total pipes		7,124
Total bells		69
Total pipes and bells		7,193

The organ is practically concealed in the prosceni um and is supplemented by two others, one an echo organ, erected within the dome and immediately above the centre of the parquet, distant about 100 feet from the organist; the other a stage organ, placed within a swell box sufficiently high on the stage wall to allow of walking beneath it. A striking feature of the stage organ is a set of twenty-five brass tubes that serve as chime bells. On being struck by hammers controlled and operated from a keyboard by the closing of an electric circuit, they give out a full and resonant tone, rich in harmony and far more realistic than if bells of usual shape were employed. In addition to these chimes there are a set of brilliant-toned carillons, formed of forty-four steel bars, operated in a similar manner. The keyboard controls seven different departments of the organ, namely, the great, pedal, swell, choir, echo, solo and stage. The keyboard extends below the floor of the hall, and contains the delicate combination action and electric circuit-closing apparatus.

The smaller electric light plant that will serve the hotel, and which is located on the Michigan avenue side of the building, consists of three Williams high-speed compound engines of 125 h. p. each and an Ideal engine of 100 h. p., each engine driving a No. 32 1,400-light Edison dynamo, while a Bullock Straight Line of 40 h. p. drives a 450 light dynamo.

The hydraulic system in the Auditorium is worthy of reference in closing this sketch, as it is perfect in all its details and is said to be the largest isolated hydraulic plant in the world. At the base of the system are some twenty-five pumps of the Worthington compound and high-pressure type, having an aggregate capacity sufficient at ordinary speed to raise from 19,000,000 to 20,000,000 gallons of water every twenty-four hours, or an amount greater than is probably consumed daily in any city of less than 200,000 population, so that the average allowance of water per inhabitant is 100 gallons per day. These pumps supply all the water required for house-supply purposes, for feeding the great tanks placed in the tower, 180 feet above the sidewalk, and for the cooling apparatus. Nineteen Worthington rams furnish the power that, by the throwing of a lever or series of levers, moves the "bridges" and the "traps," the larger and the smaller of the iron curtains, the "flies" and other accessories, all of iron or steel, and amounting in weight in the aggregate to over 500 tons.

Tempered Copper for Electrical Work.

BY GEO. H. BLISS.

My attention was called some time since to the claims of the Eureka Tempered Copper Company, of North East, Pa. Considering the subject novel and of great importance to the electrical art, I arranged, on a recent Eastern trip, to pay a visit to the above named establishment.

North East is a small town in the Pan Handle of Pennsylvania, situated on Lake Erie, and through which the Lake Shore road runs, so that it is not a difficult point to reach, as might be first supposed.

It has some natural advantages for the business, and being the home of Mr. Alfred Short, the president of the company, and near to Erie, Pa., which is the residence of the Hon. W. L. Scott, who is largely interested in the enterprise, was finally chosen as the headquarters for the business.

I am quite sure that any one interested in electrical industries and who has the opportunity will feel well repaid for stopping at North East to investigate this matter, and will find Mr. Short ever ready to make fully understood the many valuable uses to which tempered copper can be applied.

The business is new, but it has already outgrown the early quarters provided, and substantial brick buildings of considerable extent are being erected, so that a rapidly growing trade can be handled with promptness and success.

It is a general belief that the ancient nations, both in the old and the new world, possessed knowledge which enabled them to temper copper, and they are known to have used it for edged tools. Samples of these tools have been found in many places, but I believe that an analysis of the materials of which they were composed reveals in all cases the presence of alloys, and while such tools have been hardened in a degree, it is evident that there exists a wide difference between the method of the ancients and the modern process.

Mr. Almer Thomas, who devised the present process of tempering copper, is therefore something more than a re-discoverer, for he is the inventor of a new means for tempering copper without the aid of alloys.

The importance of this fact is well understood among electricians, for any alloy in copper decreases its conductivity and diminishes the value for electrical uses.

I regret not having on hand a table showing the results of a large number of electrical measurements upon samples of tempered copper, but it has been conclusively demonstrated that the modern tempering process does not injure in the slightest degree the conductivity of the copper.

The following analysis of several samples of tempered copper were made by Dr. F. A. Genth, of Philadelphia, Pa., Nov. 1, 1889. The figures show conclusively that foreign materials are not introduced in tempering the copper, and that it remains in a pure state.

	1. Pig copper.	2. Edge pieces.	3. Castings.
Silver	0.096	0.053	0.095
Copper	99.890	99.961	99.914
Tin	trace	0.045	0.094
Lead	"	trace	trace
Iron	0.056	0.069	0.056
	100.042	100.128	100.159

The value of tempered copper in connection with heavy machinery where large weights must be sustained depends upon its ability to resist compression.

The following compression tests made by the Brooks Locomotive Works, Dunkirk, N. Y., May 24, 1889, indicates the remarkable value of tempered copper in the mechanic arts, where pure copper heretofore has not been available:

TEMPERED COPPER IN COMPRESSION.

No. 2. 80,000 pounds load.	Diameter .961 inches Total length.	Length 1.83 inches. Pounds load.	Area .722 inches. Total length.
0	1.830	60,000	1.120
2,000	1.825	64,000	1.080
4,000	1.815	68,000	1.025
6,000	1.815	72,000	.980
8,000	1.800	76,000	.945
10,000	1.795	80,000	.900
12,000	1.770		
14,000	1.770		
16,000	1.740		
18,000	1.720		
20,000	1.690		
22,000	1.665		
24,000	1.640		
26,000	1.606		
28,000	1.585		
30,000	1.545		
32,000	1.520		
34,000	1.495		
36,000	1.462		
38,000	1.430		
40,000	1.400		
42,000	1.375		
44,000	1.335		
46,000	1.310		
48,000	1.280		
50,000	1.255		
52,000	1.235		
56,000	1.170		

NOTE.—The 80,000 pounds above corresponds to 110,803 pounds per square inch. Measurement of deflection taken roughly with ordinary calipers.

Still more valuable to the electrical fraternity are the tests made by the same parties and at the same time and place, showing the great tensile strength of pure copper. The following is the table:

TEMPERED COPPER IN TENSION.

Pounds load.	Diam. .797 in. Lbs. load to sq. in.	Length 3 in. Total length, inches.	Area. 50 inches. Total elongation.
0	0	3.000	0
1,000	2,000	3.000	slight
2,000	4,000	3.000	do
3,000	6,000	3.000	do
4,000	8,000	3.000	do
5,000	10,000	3.005	.005
6,000	12,000	3.015	.015
7,000	14,000	3.040	.040
8,000	16,000	3.075	.075
9,000	18,000	3.110	.110
10,000	20,000	3.140	.140
11,000	22,000	3.195	.195
12,000	24,000	3.250	.250
13,000	26,000	3.320	.320
14,000	28,000	3.400	.400
15,000	30,000	3.510	.510

15,220 pounds, breaking load.
Tensile strength, per square inch, 30,440 pounds.
Breaking stress, per square inch, 30,440 pounds.
Elastic limit (approximated), 9,000 pounds.
Total elongation, 17 per cent.

By the Thomas process copper is tempered to almost any degree of hardness. Its tensile strength is easily made four or five times that of pure copper and much superior to hard drawn copper. Its utility for overhead electrical conductors where strength and high conductivity must be had, is superior to that of copper in any other form.

Alloys of all kinds make copper brittle, whereas tempered copper becomes so tough that four sharp kinks are required to break it, while one is sufficient to break ordinary copper.

Many of THE ELECTRICAL WORLD readers are familiar with the fact that it has heretofore been impossible to make perfect castings of pure copper. The process devised by Mr. Thomas overcomes this difficulty, and the Eureka Tempered Copper Company furnish pure copper castings of any desired dimensions. These castings are tempered when required to any degree of hardness.

It is a well known fact that alloyed copper is quickly attached by alkali, salt water and mercury.

Pure copper is much less affected, and it is, therefore, practicable to use tempered copper in the form of castings, sheets and wire in many places where alloyed copper is not available. Few of us ever supposed that copper would be used for springs, and yet this is practicable and desirable, when tempered, for many applications. It is amusing and surprising to listen to the clear ring of a bell made from pure tempered copper, but this is one of its uses.

The merits of tempered copper have been quickly recognized by many in the electrical fraternity, and already such companies as the Edison, Thomson-Houston and Westinghouse, who are anxious to supply their customers with the best machinery, are using it to a considerable extent. Its superiority over drop forged castings for commutators and many purposes is readily apparent.

Drop forged castings necessarily have greater electrical resistances than pure copper. Pure copper, properly tempered, when used in commutators, will outlast four or five ordinary commutators, as has been demonstrated by experience.

Tempered copper, when used for gear wheels for electric motors, is noiseless and outlasts anything else. It is next to impossible to break or twist off a tooth in a tempered copper gear wheel.

The great advantages of tempered copper for journals has been amply demonstrated. Locomotives have run thousands of miles with journals of this material without heating and with little wear. It has been applied to journals where the speed is 7,500 revolutions per minute with success.

Little oil is required upon the journals where it is used, and the economy in attention and repairs is considerable. The uses to which tempered copper can be applied are multiplying daily and seem to be held in check only by the considerable cost of the article.

To those in the electrical profession who have not given the subject attention, it is worthy of early consideration. No one can investigate it without being convinced that its extended use will greatly increase the efficiency, reliability and durability in every branch of electrical construction.

Electric Lighting in the Convention City.

The Kansas City *Times* has the following interesting notes about the local electric light plants. We have added a few details:

KANSAS CITY ELECTRIC LIGHT COMPANY.

The Kansas City Electric Light Company is the successor of a company organized in Kansas City in 1881. Judge William Holmes was its first president, L. R. Moore, vice-president, and J. S. Chick, treasurer. The company controls all apparatus manufactured by the Thomson-Houston Company, of Boston, for this point. Kansas City is the oldest Thomson-Houston station in the world, and the Kansas City plant was the first established by that now celebrated company. The Kansas City Electric Light Company's plant is large, its arc light capacity being 930 lamps, 710 of which are now in service.

The aggregate horse power of the plant is twelve hundred, supplied by three Babcock & Wilcox boilers, and eight boilers of the ordinary type. The machinery is driven by ten engines of very superior make and finish. They have also the Thomson-Houston incandescent system and lamps to the number of 1,500. All the indandescent lighting, and nearly all the arc lighting, is in commercial business, only eighty-eight arc lamps, five of which are free, being in the service of the city. These lamps are scattered from the State line to Chestnut street, and from the river to Twenty-third street, requiring over sixty miles of circuit to reach these points. The present officers of the company are: W. B. Grimes, president; F. K. Hoover, vice-president; J. S. Chick, treasurer; E. R. Weeks, general manager, and C. A. Harber, superintendent. The directors are Messrs. Grimes, Hoover, Chick and Weeks, together with J. H. North, W. B. Grimes, Jr., F. N. Chick, J. Scannon, O. H. Dean. All the stock is owned in Kansas City.

EDISON ELECTRIC LIGHT COMPANY.

The company was organized in 1887 with George H. Nettleton, president; Kersey Coates, vice-president; C. W. Whitehead, secretary and treasurer. It owns and controls all the patent apparatus manufactured by the Edison company of New York for Jackson County, Missouri, and Wyandotte County, Kansas. The plant is located on Wall street. It has a present station capacity of 6,000 lights, 5,000 of which are in service. The plant comprises three large boilers with 600 h. p., three New York Safety engines which drive six large Edison dynamos. The officers of the company are: W. B. Grimes, president; F. K. Hoover, vice-president; J. S. Chick, treasurer; E. R. Weeks, general manager; W. B. Grimes, Jr., secretary, and G. W. Hart, superintendent. The company only furnishes incandescent light. Messrs. Grimes, senior and junior; Hoover Chick and Weeks are directors, with J. H. North, O. H Dean, and W. P. Hix.

THE SPERRY ELECTRIC LIGHT COMPANY.

The Sperry Associate Electric Light Company was organized in 1886, with J. J. Everingham, president, and James Scannon, secretary and treasurer. It has a plant for 300 arc lamps, and has recently started a Westinghouse incandescent plant of 3,000 lamps capacity, which many residences on the west and south side and all the retail shops on the south side of Twelfth street use. This company is the lessee of the Westinghouse Electric Company. The officers of the company at present are: Fred Howard, president; James Scannon, vice-president; W. F. Sargent, secretary and treasurer, and E. R. Weeks, general manager.

We may add that the Edison Company has a capital invested of $125,000; the Kansas City Company of $450,000, and the Sperry Company of $60,000.

THE AMERICAN ELECTRIC LIGHT COMPANY.

The American Electric Light Company's plant is located at Twentieth and Central streets. It has three boilers and three engines. They use the Ball and American arc light dynamos, supplying 250 arc lights; the Heisler incandescent system, one dynamo furnishing 300 incandescent lights. The company's service has more than doubled during 1889, and $7,000 has been expended during the year in building, new machinery and other improvement.

THE INTERSTATE ELECTRIC COMPANY.

The Interstate Electric Company has increased its capacity during the past year from 2,500 incandescent lights to 10,000, and its horse-power from 100 to 500. It is the only company using storage batteries. There are four battery stations in the city. During the year Paul W. Bossart has retired from the management and has been succeeded by T. F. Clohesy.

SOUTHWESTERN ELECTRICAL SUPPLY COMPANY.

The Southwestern Electrical Supply Company, with general offices at 910 and 911 New York Life Building, and large and commodious warerooms at 1,304 St. Louis avenue, have been closely allied to all the industries that have marked the progress of electricity in connection with its application to light and power in Kansas City and the great Southwest. The formation and incorporation of this company some four years ago marked the birth of a particular kind of jobbing trade which had never before received any attention in any city west of Chicago. From that time until the present this company has sent its goods into every State west of the Mississippi. Companies operating electric light and power plants, electric street railways and kindred enterprises appreciate a Southwestern depot for such material as they require from month to month in the construction and operation of such plants, and their appreciation is recognized by the fact that the trade with this company has wonderfully increased during the period since its inception.

Everything required in the construction and operation of electric light and power plants can be furnished on short notice from their stock, which obviates much of the difficulty and vexation caused by delays incident to orders placed with Eastern houses. Its patrons are located at points in Missouri, Kansas, Nebraska, Texas, Arkansas, Indian Territory, New Mexico, Arizona, Colorado, Utah,

Washington, California, Idaho and Nevada. No business concern in Kansas City won its way to the front with greater success in the years that it has been established here. All its contracts are filled promptly, and those who are patrons of the company are loud in their praise of its perfectly fair and honest dealing. Such houses are a credit to any city.

Cornell University Items.

Prof. Nichols' lectures this term are on "The Theory and Construction of the Dynamo."

Senior mechanical laboratory practice has been modified so as to more completely meet the needs of electrical students. A number of seniors are busy at work in the mechanical laboratory installing a complete Thomson-Houston arc-lighting plant. The plant is for experimental purposes only, but it is intended to have it resemble as nearly as possible the ordinary city lighting plant, except in the matter of the length of circuit, which will, unfortunately—or fortunately—be rather limited. The dynamo, mounted on a cradle, is to be run by the Ide engine, a Sibley workshop product. Complete tests of engine, dynamo, lamps, line, etc., and of the efficiency of the system as a whole, will be made.

In the list of thesis subjects just made public are to be noted numerous, what promise to be extremely interesting, studies. Among them may be mentioned arc-light carbons, curves of magnetization of various grades of cast iron, the general subject of hysteresis, test of the new Westinghouse (Stanley) alternating current dynamo, etc., etc. Most of the students will do their thesis work in our own laboratory, but a number will do out-of-town work in efficiency tests of street railroads, converters, etc.

Prof. Ryan has under consideration a plan for the rearrangement of the "Sibley plant" for lighting the University buildings and the campus, looking toward a more economical distribution and a better use of facilities and apparatus already at hand. The library has been recently rewired and newly fitted throughout with incandescent lamps. All work of this kind is done by students, who are thus able to happily combine theory and practice.

Nothing definite is known at this early date of the itinerary of the annual inspection tours of Sibley men. The present plans, however, for the electrical engineers' trip contemplate two sections, both going east, one by way of Philadelphia, the other by way of Boston, the two to unite in New York.

There will also be a western section visiting Buffalo, Cleveland, Pittsburgh, etc., if a sufficient number signify their desire for such a trip.

Lieutenant Fiske on Electricity in Warfare.

On Jan. 20, Lieutenant Bradley A. Fiske, of the U. S. Navy, delivered a lecture on the above subject before the Franklin Institute, Philadelphia, in the course of which he detailed all the modern applications of electricity to this work. Referring particularly to the increased application on board ship, Lieutenant Fiske said: It is in the modern warship that electricity finds its broadest field; in no other equal space can there anywhere be found so many, so various and so important forms of apparatus. Hydraulic machinery is usually employed in the navies of Europe for quickly bringing heavy guns to point at the target. But in the United States ship "Chicago," our newest and best cruiser, one of the eight-inch guns is trained by an electric motor, and with gratifying results. The gun can be trained much quicker than by hand; but this is not the real element of superiority. The real element is the absolute control possessed by the gun captain. A small lever protrudes in the rear of the gun, and this lever is so connected with a peculiar switch on the motor that the gun follows this lever, like an obedient child. If the gun captain wishes to move the breech of the gun to the right, he moves the lever to the right, as though it were really the gun itself, and the gun immediately moves to the right, slowly or fast, just as the lever moves; and when the lever stops, the gun stops; the reverse operation occurs if the lever is moved to the left. It will be seen that this plan dispenses with any arbitrary motions, so that a person entirely ignorant of electricity can control the gun.

But it is not enough that guns be handled with rapidity and precision—they must be supplied with a constant stream of ammunition. The problem of supplying ammunition with sufficient rapidity to carry on a modern engagement is also coming to the front as one of the most important problems pressing for solution. The ammunition hoist now on board the "Atlanta" is a step in this direction, furnishing, as it does, a means for raising ammunition to the deck quicker than by hand, with greater safety, and with fewer men, thus allowing the extra men to work at the guns. In this hoist, as in the gun-training apparatus, the same idea is carried out, *i. e.*, that of making the electric motor follow the motions of the operator's hands, both in direction and speed. The advantage of this plan in the case of an ammunition hoist, will be apparent when it is stated that the entire time required on board of the "Atlanta" to raise a 250-pound shell, is 9½ seconds. Now, this interval gives a man very little time to think, especially in excitement or danger; and if the ordinary arbitrary movements for starting and stopping motors were employed, an accident would some day result from the wrong movement being made. Furthermore, with this device, if the operator is killed, or if he lets go the handle, or if, through excitement or confusion, he ceases to pay attention to the handle, or if a shot disables the motor, or breaks its connections, in all these cases everything stops and the shell simply stays where it is. This is a much better thing for it to do than to violently descend, or be forced up against the deck overhead, as would happen with any other device now known.

The two plans described comprise the principal uses, besides ventilating, to which electric motors have as yet been put in ships; but in the near future it is expected that they will largely replace the many small steam engines with which modern warships are filled.

A very great increase in the accuracy of gunnery at sea is secured by the plan now coming into use in all civilized navies, by which the guns are discharged by electricity.

The gun captain holds a small circuit closer in his hand, and as soon as the rolling of the ship brings the sights level with the target, he simply presses his finger without bothering himself to see if the men are away from the gun, because the recoil will not hurt them. It must be borne in mind that the real errors in shooting at sea are not in shooting to the right or the left of the target, but in shooting over it or short of it. This shooting over or short arises from two things—first, having a mistaken idea of the distance; second, firing too soon or too late when the ship is rolling. Now, a range finder eliminates this first error, and electric firing goes a great way toward eliminating the second error, principally because it obviates the necessity for making any allowance for delay in the firing of the gun after the gun captain has done his part.

I fancy that everybody here is aware of the fact that the great need of all navies is a quicker and more trustworthy means of communication between ships at sea. Doubtless most of you know also that many experiments have been made looking to the establishment of a means of communication by electricity. Two general lines of experiments have been followed; in one sound vibrations are set in motion in the water, and are received on a diaphragm, usually on the under water side of a ship, this diaphragm corresponding to a telephone transmitter, the receiver being in the pilot house, or other convenient place. The other line contemplates sending electric signals through the air or the water, the receiver being usually a telephone receiver. During about two years a great many experiments at the New York Navy Yard were made in the latter line, signaling both through the air and through the water. These experiments were on a pretty large scale. A large dynamo was used as a source of power, and in one case the U. S. S. "Atlanta" was converted into the largest electro-magnet known, being wrapped with heavy wire, through which the dynamo current was sent, while the iron tug "Nina" was made a receiver, she being wrapped with fine wire, having a telephone in circuit. But the most satisfactory results were got by sending the impulses through the water; and, though nothing quite practical was reached, yet one felt all the time that it was because he was not prosecuting the experiments correctly. These experiments seem worthy of mention, because they indicate one of the few fields of electrical engineering not yet explored.

The Edinburgh Exhibition.

The Executive Council have decided to finally close the list of applications for space on Jan. 15, when allotment will be proceeded with. Among the electrical exhibitors are: Sir William Thomson, Mr. W. H. Preece, Mr. Edison, the General Post Office, Edison-Swan Company, Laing, Wharton & Down, Brush Company, Paterson & Cooper, United Electrical Engineering Company, King, Brown & Co., Muir, Mavor & Coulson, (Limited); Elmore Copper Depositing Company, Thomson-Houston Welding Company, Newall Engine Company, Robey & Co., Electric Traction Company, Ernest Scott & Co., Ronald Scott, Woodhouse & Rawson, Buller, Jobson & Co., W. T. Glover & Co., National Telephone Company, Consolidated Telephone Construction Company, Colonel Gouraud, Gent & Co., Exchange Telegraph Company, Eastern Telegraph Company, etc., etc. The Decauville Company propose to show a narrow-gauge railway in operation, but worked by electricity in lieu of steam. The Executive Council have arranged with Messrs. Immisch & Co. for a 10 minutes' service of electric launches on the Union Canal between Fountain Bridge and the Exhibition. In addition to the British Electrical contingent, about 150 electrical exhibits are expected from France, where the Government have officially recognized the Exhibition, and considerable numbers from other foreign countries.

Hazard from Outside Electric Currents.

The Boston Manufacturers' Mutual Fire Insurance Company has sent us the following special circular, No. 28, as to protection against these risks, showing what is no doubt the best system of protection against these dangers:

Electric lighting was first introduced in a very few risks insured by this company before the year 1881; in that year, and in the first six months of 1882, it was adopted in a very considerable measure. In this period of its early introduction, prior to April 1, 1882, we received notice of 23 fires which had been set by the electric current in only 61 mills which had then been equipped. No claim for loss was made in any of these fires, but they disclosed conditions which were very alarming to us. An immediate investigation was made, under the direction of Mr. C. J. H. Woodbury, and certain rules were adopted for putting up the apparatus, insulating the wires and guarding against the dangers disclosed in these 23 fires. These rules were immediately submitted to all the electric light companies or manufacturers of electric lighting apparatus who had any standing in the community, and were at once adopted by them as well as by all insurance companies. They have not been changed since that date except so far as new inventions have called for modifications.

Since April 1, 1882, a period of nearly eight years, we have received no notice of any fire which could be attributed to electricity in any risk insured by this company, and of course no claim has been made upon us for a loss which could be attributed to this cause. Our experience, therefore, justifies the conclusion to which we came after the first two years of electric lighting—that under proper safeguards it is the safest method of lighting that can be introduced. Electricity has also been applied in some of the works insured by us as a motive power, and electricity is now applied to lighting or motive power in over 600 risks which are insured by the Factory Mutual Companies.

Attention, however, has lately been called to the danger of wild currents of electricity generated on the wires which may be in use for lighting, for power, and for the railway service in many cities. There appears to be very little doubt that the recent destructive fire in Boston originated in the diversion of a high tension current of electricity from its own wire to an electric clock wire, on which it was carried to the building in which the fire originated. There appears to be little doubt that this conflagration may be attributed to the lack of precaution in guarding against an outside current of electricity. Such currents may be carried from their proper wires to other points in all cities or towns in which electric light or power is widely distributed in the public streets or over private buildings.

In order to guard against this hazard, the owners and manager of mills and works insured are advised to establish the following rules for the protection of their premises. These rules, after having been drawn by us, have been submitted to experts in various branches of electric science who are of the highest authority. The forms have been modified by them, again considered on our own part, and are believed to be suitable for what may be called an emergency.

The following are the rules of the Boston Manufacturers' Mutual Fire Insurance Company for guarding insured property against the hazard of stray currents of electricity generated outside of mill yards:

1. No foreign wires of any kind shall be attached to buildings insured by this company, for the purpose of carrying electric currents across the yard to any point.

2. All electric wires which may be required by the insured shall enter the premises at one point near the headquarters of the night watchman, where they can be kept under supervision; each of said wires shall be guarded by a protector against strong currents, operating by opening the circuit, and by a lightning arrester.

3. Such protectors against strong currents shall be located in a dry, accessible place inside the building, and as near the point of entrance of wires as possible, and shall be without ground connections; such protectors shall be mounted on non-combustible and insulated supports, which shall be provided with a receptacle for the burning of melted parts of such apparatus.

4. The lightning arresters on all wires must be placed between the protector against strong currents and the electrical portion of the apparatus within the building to which such wires are connected. No ground wires for such lightning arrester shall be attached to gas pipes within the premises of the insured.

5. All electric wires which may enter the premises of the insured must be insulated between the line wire on the insulator attached to the building outside and the protection device within, with the best quality of waterproof insulation. Moreover, such wires must enter at a distance of not less than three inches from any other wire or any conducting material.

6. If any wires carrying high tension or strong currents are to be carried over or under other wires on the property of the insured, they shall be attached to poles so near to each other, with one wire so far above the other, that if a break should occur, the pendent wire between these poles may not be long enough to come into contact with the wire below, or, if not carried on poles, these wires shall be so placed or protected with guard wires as to render a contact between different wires impossible.

7. If the high and low tension systems are in use in the same yard, even when developed within the works, the wires must be kept separate, and so wide apart that no contact or cross arc can be made.

A Complimentary Dinner to Mr. E. H. Johnson.

In the view of the retirement of Mr. E. H. Johnson from the presidency of the Sprague Company, a number of gentlemen who have been closely associated with him in its affairs welcomed him to a banquet at the Hoffman House on Jan. 20. The table was presided over by the ever witty John S. Wise, and Mr. Frank J. Sprague acted as vice-chairman, these gentlemen being assisted by Mr. H. McL. Harding and Mr. J. L. Barclay. Among others present were: Messrs. Saml. Insull, J. H Vail, S. Dana Greene, Cary T. Hutchinson, J. Muir, F. Johnson, C. W. Price, T. C. Martin, and representatives of the daily press.

The evening was a most pleasant and memorable one, and the speeches were all characterized by a desire to render justice to Mr. Johnson as a man whose work has done so much to promote the welfare of electrical industries in America. The general feeling was voiced in the following address, which was read by Mr. J. H. Vail:

The undersigned, officers and employés of the Sprague Electric Railway and Motor Company, upon your retirement from the presidency of this company, beg leave to present to you in this form an expression of their sentiments toward you, and of their deep regret at your resignation.

They realize that to your efforts, as much as to those of any one man, was due the birth of the Sprague Company.

Your keen foresight as to the possibilities of electric propulsion brought to this enterprise in its infancy, in large part, the business energy and the means wherewith its success was made possible.

Your ceaseless advocacy of its merits and faith in its future were largely instrumental in establishing the public confidence it now enjoys. Under your administration the business has been developed to its present great proportions, and the Sprague Company, the pioneer in the problem of street car propulsion, placed at the head of that branch of American enterprise.

A company which has derived such great benefit from your services can ill afford to lose them. Outside of this business aspect, we would add that each and all of us feel a sense of personal loss at your resignation.

Not one of us but recalls the fact that your management has been marked by such candid criticisms of faults as to exclude the fear of secret dissatisfaction; while, on the other hand, we recall instances of generosity, considerate kindness and interest in our personal welfare, endearing you to us by something more than mere business ties. You carry with you our hearts, as well as our confidence that success awaits you in whatever new enterprise may engage your energies.

While this testimonial but feebly expresses the large and enduring admiration we have for your great business capacity and your eminent virtue, you are assured that your future will be ever followed by our sincere wishes for an unqualified success, and that as long as memory endures you will retain the grateful and affectionate regard of those who are proud to be named among your friends and business associates.

Mr. Vail stated that this address would be suitably engrossed, and on formal presentation would bear the signatures of those offering it. They are as follows:

Frank J. Sprague, J. H. Vail, Jno. S. Wise, Arthur S. Beves, J. H. McClement, H. McL. Harding, A. T. Starkey, C. W. Jenks, Whitney W. Munroe, C. F. Hannington, J. L. Barclay, C. A Benton, D. C. Jackson, W. S. Kelley, H. F. Parshall, C. T. Hutchinson, W. H. Churchill, E. Whitestone, H. K. Browne, F. A. Mason, J. A. McLure, F. S. T. Branth, A. W. McClement, R. K. Case, H. W. Blake, H. T. Purdy, Patrick Shaughnessy, Jas. Wiley, Wm. Rydler, Charles Hewitt, Theodore Beran, Geo. R. Metcalfe, Samuel L. Whitestone, Samuel Stein, C. T. Hamilton, A. S. Springstein, Wm. E. Mandelick, Wright Shaw, W. F. B. Rouquette, N. Ritchie, E. Dickson, M. Hormel, J. S. Murphy, H. D. Carter, M. Meinell, M. S. Adler, E. Elliott,

Mr. Johnson's responses to the various expressions of admiration and good will were sympathetic, and, as usual, to the point, abounding also in interesting reminiscences of his long connection with Mr. Edison, and touching upon the later enterprises that have needed development in the great field of electric light and power. Mr. Insull made a brief and felicitous speech in the name of the "new Edison consolidation," and as an early associate of Mr. Johnson. Messrs. Sprague, Wise, Greene, Harding, Muir and Barclay also spoke during the evening. The party dispersed at an hour near midnight.

The Mutual Electric Insurance Company.

The reluctance with which the regular stock insurance companies have from the start accepted risks on electric light central stations, together with the high premiums exacted, some time ago led to the idea of a plan of mutual insurance. Though allowed to lag, the scheme has now been taken up in earnest, and, from the prospectus now before us, the plan and scope of the Electric Mutual Insurance Company seems eminently adapted to afford electric lighting interests relief from one of the burdens heretofore placed upon them. According to the prospectus, it is proposed to organize and incorporate a company under the above name and title for the purpose of insuring electric light and power generating or distributing stations (building and contents) throughout the United States (and possibly Canada) against loss or damage by fire, the company to be located in Boston, Mass. It is believed that the electric generating station can be made as free from fire hazard as any other class of risk where mechanical power is being utilized, and it can certainly best be made secure through some medium which shall point out safe modes of construction and equipment that do not always suggest themselves to the station managers and owners. Such a medium would be the managers and inspectors of an insurance organization having for its object the supervision of such property and the furnishing of indemnity against fire loss at its exact cost.

In order that a mutual insurance company may serve its members or policy-holders with equal benefits, it should have presented to it for insurance risks as nearly equal as possible in hazard so that they may be assumed at nearly the same rate of premium. Of course it will be impossible, owing to widely varying circumstances and conditions, to carry out the ideal of mutual insurance by having all risks exactly alike in point of hazard, and insuring them at one uniform rate; but it is believed that the company can begin business with not more than five classes, and that within one year that number can be fairly reduced to two or three by alterations and improvements made through the standardizing process under which it is proposed to work.

There are in the United States over 1,000 central stations, with a probable average valuation of not less than $25,000, making (at a moderate estimate) an insurable value aggregating $25,000,000. Of these 1,000 stations it may fairly be assumed that at least one-half would be acceptable as initial risks. It is proposed to begin with a maximum line of $25,000 on a single risk, and reduce that line according as the risk varies from the standard; so that it may be fair to assume that 500 risks at an average of say $15,000, amounting to $7,500,000, can be pledged and accepted by the company in beginning business. In New England there are 100 acceptable stations on which it is believed an average of $15,000 will be pledged at once, so that $1,500,000 can reasonably be counted on from that section alone.

Considering the rapid growth of the industry, the present tendency toward improved construction and equipment, with a view to permanency and enlargement, together with improvements that may easily be made in many of those stations that are not acceptable in their present condition, it does not seem unreasonable to predict that within one year the business of the company will be increased 50 per cent. When its success shall have been demonstrated, and its financial condition warrants, the amount carried on each risk may be increased and its volume of business thereby greatly enlarged.

It is proposed to make the initial rate on a standard station one per cent. per annum, that rate to be increased according to the application of the schedule to be adopted, but not to exceed two per cent., any station rating higher to be declined until so improved as to bring it within this limit. (A lower rate than one per cent. may be adopted for stations constructed wholly of fire-proof material.)

With the above rates, and on a basis of $7,500,000 insurance as previously estimated, it seems within the range of conservative calculation to predict a premium income of $100,000 the first year. From this income must be paid all expenses, such as salaries of officers, inspectors, and clerks; traveling, incidental and office expenses, and taxes; also all losses by fire. Calculating from statistics of fire losses already at hand, a good dividend can be expected; but the promoters of the company are sanguine in their belief that through their selection of risks, and the avoidance of losses by gradual improvements that will be carried out, and by the system of inspection that will be maintained, the loss ratio can be so reduced as to enable the company to return the policy-holders at expiration of policies from fifty per cent. to seventy-five per cent. of the premiums paid, on the basis of rates previously named.

It is proposed to maintain a system of inspection, giving each station as many examinations per year as may be thought advisable by the directors. For this purpose a sufficient number of skilled inspectors will be employed. In addition to the expectation of a materially reduced cost of insurance, it should be borne in mind by managers and owners of light and power stations that great benefit will accrue to them from the periodical visits of the competent inspector, who will be expected to give each company advice and instruction as to reducing the fire hazard, which will of itself more than compensate for the amount of premiums paid.

The prospectus is signed by Messrs. S. E. Barton and Wm. Brophy, of Boston, gentlemen well known to the electrical fraternity, and whose zeal in their behalf has often been demonstrated. The scheme as outlined above also has the indorsement of all the leading electric light companies irrespective of system, and it is to be hoped will be carried out to a successful completion.

Exhibitors at the Kansas City Convention.

Secretary Garratt favors us with the following list of exhibitors at the Kansas City Convention:

Edison Machine Works, 500 square feet; Sprague Electric Railway and Motor Company, 500 square feet; Eddy Electric Motor Company, 230 square feet; C. & C. Electric Motor Company, 230 square feet; THE ELECTRICAL WORLD, 80 square feet; *Western Electrician*, 80 square feet; *Electrical Engineer*, 80 square feet; *Electrical Power*, 80 square feet; *Electric Age*, 80 square feet; *Electrical Industries*, 80 square feet; *Modern Light and Heat*, 80 square feet; *The Electrical Review*, 80 square feet; Central Electric Manufacturing Company, Eau Claire, 160 square feet; Gate City Electrical Company, Kansas City, 110 square feet; Okonite Company, 170 square feet; National Carbon Company, Cleveland, 80 square feet; Southwestern Electrical Supply Company, Kansas City, 80 square feet; Standard Carbon Company, 80 square feet; Jewell Belting Company, 135 square feet; Charles D. Jenney & Co., 90 square feet; Charles A. Schieren & Co., 90 square feet; Royal Silk Manufacturing Company, 27 square feet; James W. Queen & Co., 135 square feet; Phœnix Glass Company, 90 square feet; Ansonia Brass and Copper Company, 90 square feet; Detroit Motor Company, 90 square feet; Fred. H. Whipple, 27 square feet; Weston Instrument Company, 81 square feet; American Electrical Works, 54 square feet; Palermo Mica Company, 27 square feet.

The following will *probably* exhibit at Kansas City: Central Electric Company, Chicago; Simplex Electrical Company, Boston; Solar Carbon Company, Pittsburgh; Munson & Co., Chicago; Riker Electric Motor Company, Brooklyn.

The Edison General Electric Company.

At the annual meeting of the Edison General Electric Company, held Jan. 20, at the company's offices, 44 Wall street, the directors were elected for this year: C. H. Coster, Joseph S. Decker, Thomas A. Edison, J. H. Herrick, Samuel Insull, E. H. Johnson, A. Marcus, Carl Schurz, Francis S. Smithers, Henry Villard and J. Hood Wright. All were re-elected but Mr. Decker, who takes Mr. Marx's place. The first annual report was submitted. It says:

"The main purpose for which the Edison General Electric Company was formed was the acquisition of the properties of the Edison Electric Light Company and of the three Edison manufacturing companies, namely, the Edison Machine Works, the Edison Lamp Company and Bergmann & Co. The purchase of the manufacturing companies carried with it the acquisition of the stocks of the Edison United Manufacturing Company and of the Canadian Edison Manufacturing Company.

"The Edison Machine Works were formerly in New York City, but were removed to Schenectady, N. Y., some years ago. Of the principle articles manufactured during the year ending Nov. 1, 1889 (dynamos and motors), there were over 2,500.

"Bergmann & Co.'s workshops occupy two large buildings, one at Avenue B and Seventeenth street, and the other at Twenty-seventh street and First avenue. The Edison Lamp Company's property is in Harrison, a suburb of Newark, N. J. Between 7,000 and 8,000 lamps are produced a day. As many as 11,000 lamps can be made in a single day.

"The United Edison Manufacturing Company has been reorganized, and is now working with a capital of $1,000,000, $500,000 of which has been paid up. The Canadian Edison Manufacturing Company has charge of the Edison manufacturing business, except the making of lamps, in Canada. Its shop is at Sherbrooke, near Quebec. The Sprague Electric Railway and Motor Company has at present in use 3,000 of its motors. The number of street railway cars equipped with electric motors during the last year by the company was 551."

Obituary—Austin Goodyear Day.

It is with great regret that we have to announce the death of Mr. A. G. Day, so well known to every electrician from his connection with "Kerite," one of the oldest and best insulating materials. We are indebted to the Seymour, Conn., *Record* for the following account of his career:

This distinguished inventor was born in West Springfield, Mass., Nov. 24, 1824. Sprung from the primitive stock of the early New England settlers, his education was carefully looked after; and, early showing a peculiar fondness for study and investigation, he was prepared in the district school for his academic studies with the view to enter college. But, fortunately perhaps—for him and the world—his talent for invention diverted him to more practical pursuits. In 1840 his cousin, Charles Goodyear, who afterwards acquired fame and fortune in the india-rubber business—made a visit to young Day's father, and took him to Northampton, where he first saw the process of manufacturing rubber goods. This incident determined his pursuit for life. But through his love of study he returned to Westfield Academy, with a desire to acquire a classical education. But during a vacation in his seventeenth year, his cousin prevailed on his father to allow him to take him to Woburn, near Boston, where Mr. Goodyear's factory was established. Captivated with the business, he went into Mr. Goodyear's service as correspondent and book-keeper.

But much of his time was spent in the study of india-rubber—its physical and chemical qualities, and the processes of its manufacture. He assisted in the vulcanization of the first two or three yards of sheet-rubber already being treated by Hayward for Goodyear. Soon afterward he went into a new factory at Springfield for the special purpose of perfecting the vulcanizing process, and applying it to all different articles desired; he also attended to the making of sixty pairs of braces, which were the first of the kind produced. From this point dates the commercial success of the india-rubber business.

He continued for several years in the service of Mr. Goodyear, instructing the workmen in the various factories set up, and conducting a vast number of experiments in applying the process of vulcanizing to numerous articles. At last, in 1844, the Goodyear patents were taken out. But long exposure to turpentine, lead and sulphur had injured his health, and he was laid up for several months. Resuming his labor, he devoted himself to the practical care of vulcanizing at the Roxbury factory all varieties of goods then known. Here he made the acquaintance of Prof. Hayes, afterwards State Assayer for Massachusetts, which proved of great value to him. It was under the general directions, and often the close inspection of the professor, that Mr. Day now prosecuted many of his experiments, with new ardor, with a view of discovering a substitute for sulphur. Although this object was not attained, his long and vared course of experiments, under the suggestions of Professor Hayes, were of the highest importance in their bearing upon his later discoveries. Again he was prostrated from the same causes, but recuperated by country air and exercise, in exhilarating sports of angling and hunting, which were his favorite pastimes.

Returning once more to his chosen business, visiting all the india rubber factories, he not only rendered most important service in improving the processes of manufacture, but he acquired a more thorough knowledge of the business than perhaps any other man possessed. It was during his experiments under Prof. Hayes at Roxbury in 1845, while vulcanizing rubber in melted sulphur, that he made many pieces of rubber of a hardness like horn, a point afterwards claimed to have been done by others, as showing a priority of experiments and inventions in producing hard, elastic rubber.

Since that time he has continued his experiments and improvements, standing foremost among the rubber manufacturers of the United States. Even the rubber manufacturers in France have sent to him for machines for some parts of their work, and it is but a few years since we had the pleasure of accompanying one of his Parisian correspondents, a native of an adjoining town, but for 26 years a resident of France, to Mr. Day's works to note the working of a machine similar to one which had been received from Mr. Day.

In 1854 Mr. Day bought a factory in Seymour, removing the business he had commenced in New Haven, and has ever since carried on the business here, latterly principally in the line of telegraph cables.

In March of 1865 the present imposing edifice was completed and the lower floors used for the submarine telegraph works, while the upper part was retained for the manufacture of the hard rubber pencils and pen holders, which has been carried on by his brothers, H. P. and E. Day. In May, 1871, Mr. Day was united in marriage with Miss Sarah A. Brixey, who survives him. The remains were interred in Trinity cemetery, where a handsome monument will be erected to his memory.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Jan. 27, 1890.

To Investigate Electricity.—The New York State Senate has voted for an electrical investigation.

Mr. H. Durant Cheever is now actively engaged with his duties as secretary of the Okonite Company, a position to which he was elected about a month ago.

Newark, N. J.—The Newark & South Orange Horse Railroad Company are contemplating the introduction of the overhead trolley system. It is reported that Mr. C. E. Haskell, of 112 Liberty street, New York, is interested in the reorganization and equipment of the company.

Commissioner Gibbens has resigned from the New York Board of Electrical Control. It is thought likely that Governor Hill may appoint Dr. Schuyler S. Wheeler to the vacancy for the remainder of the term, which expires next November, when the Board itself goes out of existence.

The John T. Noye Manufacturing Company, of Buffalo, N. Y., have recently opened an office in New York, at 89 Liberty street, and have put the same in the charge of Mr. Albert Fisher, a fully competent mechanic and engineer, who will attend to all the sales of the Rice automatic engine and the steam engineering generally for the territory of Eastern New York.

The Edison Company Ahead Again.—I understand Mr. F. E. Kinsman, president of the Electric Construction and Supply Company, 18 Cortlandt street, has sold his controlling interest in the above company to the Edison Company, which has secured a bargain in the Kinsman arc lamp, single and double carbon, for incandescent direct and alternating circuits. I am not surprised at this deal, as the Edison Company has shown great zeal in the introduction of this lamp, large numbers of which have been put on their circuits in this city. Mr. Kinsman, I understand, will devote his spare time to the improving, promoting and developing of his electric ice-cutting machine, for which there is a big field. It can be run by direct current, with flexible conductor, or by storage batteries.

To Fight for Quotations.—President Wilson, of the Consolidated Exchange, says that, in the event of the quotations of the Stock Exchange being sent first to those who are members of the Exchange, as is proposed by the purchase of the control of the New York Stock Quotation Company, the courts would be resorted to to prevent such discrimination. He argues that the Consolidated Exchange had no need of the quotations of the big Exchange, except as a guide, but it did want them for that purpose, and it proposed to fight to get them. The Supreme Court of the United States, he asserted, had decided that an association which depended on the public for support had no right to discriminate against the public. Another thing was the fact that the New York Stock Exchange Quotation Company had been incorporated under the General Telegraph act of 1848, and companies chartered under that act had repeatedly been determined to be common carriers. The Consolidated Exchange now depends on two Gold and Stock instruments, which it retains under an injunction, and it will have no difficulty until the "preferred" service begins. This will be as soon as the instruments of the new company have been placed in the offices of all the members of the Exchange that desire them, a work that will require two or three weeks.

D. Frisbie & Co., 112 Liberty street, manufacturers of the Frisbie friction clutch pulleys, cut-off coupling pulleys, elevators, hoistings, etc., have found a large field for their products in electric light stations, to the equipment of which they pay special attention. Among their recent orders have been pulleys for the dynamos in the New York *Sun* building, and for the Greene School of Science, in Princeton, N. J. One large contract has been for three friction clutch pulleys of 500 h. p. each for the Pleasant Valley electric road in Pittsburgh. They have also recently furnished pulleys of their friction clutch type to the T. New Manufacturing Company; and the Spiral Weld Tube Company, East Orange, N. J. The Frisbies have supplied all the clutches for the plants in the post offices at St. Louis, Chicago, Philadelphia, etc. The concern are prepared to carry out the largest power insulations for electric light plants, and will estimate upon any needed equipment for electric light and power work, and their long experience and high reputation guarantee a satisfactory performance of any work intrusted to them.

The Law Battery Company, of 85 John street, have made up their books for the past year, and find that their sales of the new form of battery have more than equaled the total sales of several years past. The gross sales run to 112,000 cells. In a very pretty little circular that the company have just issued in regard to their excellent battery they say: "This battery has been brought to a high state of perfection. Its performance is now of the highest order. It is perfectly uniform and reliable in action. It is of faultless construction and beautiful appearance. In these respects it is unapproached. Its electromotive force is 1.5 volts, and its internal resistance .5 of an ohm at the start, and continues the same until the zinc is consumed or solution exhausted. At this date it has been on the electrical market for nine years, and tens of thousands are now in use throughout the length and breadth of the land, and thousands have been exported. Cells put in use in 1881 are still working, and working as well as at their start; nothing but the zinc and the solution, costing but a few cents, ever having been renewed. In all porous-cup and other forms of batteries which require the periodical renewal of the negative element, the first cost of the cell is insignificant as compared with the cost of the renewals. The sale of these perishable negative elements is the chief source of profit to the makers of the batteries in which such elements are employed. The negative element in the Law battery is everlasting, and to remove any doubt or question on the point, the Law Company will, at any time and without charge, furnish a new one for each old one returned."

The Standard Underground Cable Company.—The old proverb, "'Tis an ill wind blows nobody good," receives a new verification in the fact that during the recent agitation concerning underground wires in New York the Standard Underground Cable Company sold during the past seven months to the various electric light and power companies, for use in New York City alone, over 1,500,000 feet of underground lead-covered cables for arc and incandescent lighting, the conductors ranging from No. 6 B. & S. G. to 400,000 circular mils, and for telephone, telegraph and fire alarm service over 5,000,000 feet of conductor. The conductors of the electric light cables were made up chiefly of No. 14 B. & S. G. copper strands. It is a fact worthy of mention that if the quantity of No. 14 B. & S. G. copper strand which went to make up the large electric light cables and the telegraph and fire-alarm cables sold by this company to their New York customers alone during the year 1889 were arranged in consecutive lengths, it would reach the enormous distance of 13,000 miles or more than half way round the globe; and this without including large sales of line and house house wires and of cable with conductors smaller than No. 14 B. & S. G. for telephone, electric bell, burglar alarm and other light work. The phenomenal growth of the Standard Company can be more fully appreciated when it is known that within the past year they have twice doubled their manufacturing capacity—in the first instance by adding two additional stories to their main building at Pittsburgh, and again by building an additional factory adjacent to their old works; and even now, with their improved facilities for the manufacture and handling of their underground cables and aerial wires they are, and have been for six months, compelled to run night and day to keep pace with orders. The very large orders for underground wires received by the Standard Company from all parts of the United States and Canada show how wide-spread is the feeling in favor of placing the wires underground. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, Jan. 25, 1890.

Mr. George Westinghouse, Jr., and family are at present sojourning in this city.

Mr. W. P. Nicholls, of the Central Thomson-Houston Electric Company of Cincinnati, has been in Boston for a few days, and spent some time in the rooms of the Boston Electric Club.

Meigs Elevated Railroad Company have petitioned the Senate for rights of way, location, etc., to operate an elevated road in any or all of the cities of the commonwealth. On motion of Senator Cook the petition went over.

Mr. Roswell P. Smith favored me with a call this week, and reports the demand for Connecticut motors as being quite brisk. Mr. Smith is agent for the Connecticut Motor Company and the Russian Belt Dressing Company, and makes his headquarters at 27 School street, Boston.

Providence, R. I.—The Providence, Warren & Bristol Railroad Company have applied to the General Assembly for permission to erect an elevated road from Fox Point to the Union Depot in Providence. If the scheme goes through this will be the first elevated track in the State.

Discussed Electric Lighting.—The Wellesley Club held their second regular dinner at the Thorndike Hotel, Boston, this week, and had as an after-dinner talk a discussion on "Electric Lighting." This is becoming a favorite topic for clubs now-a-days,

and is an excellent method of imparting useful information to the uninitiated.

Concord, N. H.—The Concord Street Railroad Company have recently contracted with the Tripp Manufacturing Company, of Boston, for eight of their special trucks, fitted with the Tripp anti-friction bearings. The railroad company has adopted the Thomson-Houston system, and the road will be operated by electricity after May 1, 1890.

G. D. Haynes & Co. have just put in a neat and novel switch-board on soapstone case for the Boston *Herald* Publishing Company, of Boston. The switchboard is for ten circuits, and is fitted with a new style of transfer switch, so that the circuits can be transfered from one dynamo to another without shutting down the plant or putting out the lights.

A Rotary Arc Lamp.—Heymann Brothers, of Boston, have completed their new rotary arc lamp and will put it on the market within the next few weeks. This lamp, instead of burning ordinary pencil carbons, has carbon discs, between which the arc takes place, and which revolve as they wear away. These lamps will burn probably from 40 to 50 hours.

Mr. M. S. Kahurl, chief draughtsman of the Riley Elevated Construction Company of Boston, has recently completed a very thorough set of plans of the proposed Riley elevated system. These plans have taken over a year to make, and are probably the most complete set of plans of an elevated railway in existence. Mr. Kahurl is yet but a young man, and has a good future before him.

West End Elevated Railroad.—The petition of the West End Street Railway Company to the Legislature for permission to erect an elevated railroad in the business parts of the city of Boston came up this week and was laid upon the table, showing that there will be a good deal of opposition. It is reported that representatives of the Manhattan system of New York have been in the city, with a view to capturing the franchise.

The Anglo-American Electric Light Manufacturing Company have purchased the Peck, Stow & Wilcox factory property at Kensington, Conn., consisting of factory, 40 × 375, with offices, buildings, dwellings, etc. They have also 200 h. p. water, with 140 acres of water shed and reservoirs. They have a large force of men putting the buildings in shape preparatory to removing their manufactory.

The Akron Iron Works, Boston, have just fitted out an electric plant in Greenwich, N. Y., through the Electric Construction Company, Greenwich, with steel-rimmed pulleys and the well-known Falls clutch. The main driving pulley is 108 inches by 38 inches wide, and there are eight friction clutch pulleys 64 inches, besides a number of smaller pulleys. The Akron Iron Works supply hangers, couplings and shafting all complete.

The Wainwright Manufacturing Company of Massachusetts have just sold a 150-h. p. heater to the Waltham Gas and Electric Company, and a 100 h. p. heater to the Gamewell Fire and Alarm Company for their new factory at Newton Upper Falls, Mass. As an evidence of the growing popularity of this heater, it is interesting to note that since the organization of this company in June they have sold over 30,000 h. p. of heaters to electric light companies alone.

The Robinson Radial Car, which has been running very successfully on the Allston and Park Square service, has been transferred to the Chestnut Hill and Tremont House route. This car continues to give great satisfaction, and is a favorite with the public on account of its steady motion, smooth action in going around corners, and entire absence of oscillation. The Robinson Radial Car Company are now having made at Newburyport, Mass., an open car capable of seating sixty persons, which they intend putting in service as soon as the summer opens.

The Thomson-Houston Electric Company reports the following sales of incandescent apparatus to central stations:

Dover, N. H., 650 lights; Norwich, Conn., 1,300; Lebanon, Ky., 650; Attica, N.Y., 650; Cynthiana, Ky., 650; Dedham, Mass., 1,300; Gloversvill, N. Y., 650; Long Branch, N. Y., 650; Jacksonville, Fla., 1,300; Mt. Clemens, Mich., 650; Santa Rosa, Cal., 650; Watsonville-Col., 300; Redding, Cal., 300; Hermansville, Mich., 650; Napierville; Ill., 300; Dixon, Ill., 650; Marshalltown, Ia., 500; Ashland, Neb., 300 Wilmington, Ill., 500; Waterlou, Ia., 650; Wichita, Kan., 650.

Reduction of Voltage in Overhead Wires.—At the regular meeting of the Common Council, held this week, it was ordered "that the joint committee appointed to consider the subject of superintendence of electric wires in the city also considers the advisability of reducing the voltage of overhead electric light wires to 500 volts." This is presumably the outcome of the recent fire scares; but it is safe to say that it will never be carried out, as the members of the Common Council become more familiar with the character of high and low tension wires and the comparative incendiary qualities of both systems. There is much for a councilman to learn.

The Thomson-Houston Electric Company reports the following sales of arc apparatus to central stations:

Providence, R. I., 50 lights; Anniston, Ala., 50; Ocala, Fla., 50; Gloversville, N. Y., 150; FallRiver, Mass., 25; New York Manhattan Company, N. Y., 100; Charleston, S. C., 90; Brooklyn, N. Y. (Citizen Company), 45; Norwich, Conn., 45; Erie, Pa., 60; Norfolk, Va., 30; Seymour, Conn., 30; Delphos, O., 85; Lebanon, Md., 70; Chambersburg, Pa., 70; Washington Court House, O., 50; Lincoln, Ill., 35; Dixon, Ill., 25; Jacksonville, Ill., 75; Grand Island, Neb., 50; Dubuque, Ia., 100; Omaha, Neb., 100; Mt. Clemens, Mich., 30; Sheboygan, Mich., 30.

The Wright Electrical Engineering Company have made a contract by which they can supply hard pine poles of any length and dimensions, within a day's notice, and at regular market prices. Common chestnut poles will also be kept in stock. The Wright Company have recently closed a contract with the Meriden Electric Light Company for incandescent wiring in stores in Meriden, Conn., for about 900 lights. Porcelain cut-outs and safety devices will be used throughout. Each transformer will be protected by special fireproof double pole switch, and the secondary circuits where they enter the buildings are run through fireproof double pole switches.

The Thomson-Houston Electric Company reports the following sales of arc and incandescent apparatus for isolated plants: Cummings & Keltron, Macomb, Ill., 30; W. D. Sheldon, Saylesville, R. I., 12; Bouton & Co., Aurora, Ill., 9; Joliet Enterprise Company, Joliet, Ill., 18 arcs. Sears Building, Boston, Mass., 200; J. S. Davidson, New York, 200; L. Prang, Roxbury, Mass., 400; R. Bishop & Co., South Boston, Mass., 200; Portland Steam Packet Company, Portland, Me., 200; Geo. F. Blake Manufacturing Company, E. Campridge, Mass., 400; Standard Sugar Refining Company, South Boston, Mass., 800; Hathaway Building, Boston, Mass., 400; J. A. Frye, Marlboro, Mass., 400; Soldiers' Home, Chelsea, Mass., 400; E. Ellsworth, Chicago, Ill., 50; *Fort Worth Gazette*, Fort Worth, Tex., 100; Miller & Phelps, Fort Dodge, Ia., 20; Golden Eagle Mill Company, Petaluma, Cal., 50; Rowes Malt Works, Waukagen, Ill., 200; A. P. Gilmore, Chicago, Ill., 350 incandescents.

K. W. Cut-Outs.—These useful cut-outs continue to have an enormous demand, and Pettingell, Andrews & Co., of Boston, are kept busy supplying them by the thousand. These cut-outs are made under patent rights, and Pettingell, Andrews & Co. have the sole right in the United States to sell them. It having recently come to their knowledge that others are manufacturing and selling an imitation of this cut-out, they have now issued a notice to the consumers that none are genuine unless stamped with their name on the back. In my notes of last week, I unintentionally gave the impression that H. E. Swift & Co., of Boston, were selling these cut-outs. My intention was to state that they were kept busy making the K. W. cut-out for Pettingell, Andrews & Co.; but Messrs. Swift & Co. have no license to sell them. So great is the demand for these cut-outs that several factories of electrical apparatus have as much as they can do in turning them out fast enough.

"The Practical Use of Electricity" was the subject of discussion at the monthly dinner of the Boston Leather and Shoe Club at the Parker House this week. Among the guests were Prof. Elihu Thomson, Prof. Charles R. Cross, F. S. Hastings, New York; H. M. Whitney, C. A. Coffin, Captain Griffin, H. A. Peaver, C. H. Newhall, J. N. Smith and H. A. Royce. Mr. Hastings briefly outlined the history of electricity, and electric lighting and power. Professor Cross explained the scientific principle of the telephone, and Professor Thomson took up the electric motor as an interesting subject, and then expressed the hope that buildings would ultimately be heated by electricity. Mr. Whitney reviewed the progress of electric railways, and Captain Griffin made an eloquent plea for the overhead wires, giving statistics of the number of deaths by electricity and other causes. He also drew attention to the almost daily and uncalled-for charges against electric wires as the cause of fire, and, after making a few statements of facts, wound up by stating that "it would seem that such a record should exonerate the electric wires from the charges brought against them."

Newport, R. I.—The Jarvis Engineering Company of Boston are actively engaged in the alteration and enlargement of the plant of the Edison Illuminating Company of Newport, R. I. This company, since its organization, has met with success almost unparalled in the history of electric lighting business, much of which is due to the active and efficient management of their general superintendent, Mr. John Whipple, Jr. Their new plant as enlarged has been designed by Mr. Whipple with a special view to the most economical production of the steam power, and consists of four horizontal tubular boilers, set with the Jarvis patent furnace to burn the cheap grades of fuel. Power for the dynamos is supplied by eight Armington & Sims engines of their improved pattern, aggregating 850 h. p., and, by direct belting, saving the expense and loss of power from the use of shafting. The exhaust steam from the engines is passed through a National heater, and utilized to heat the feed water before it enters the boilers up to a temperature of 212 degrees. An ornamental chimney of brick surmounts the entire structure, and makes this station one of the finest in New England.

Telephones for Export.—The Tropical American Company, Limited, who control the export trade in genuine Bell telephones and telephonic apparatus and supplies, report a greatly increased demand for their goods since the visit of the Pan-American delegates. This increase of business is partially due to the visit of the delegates, and partly to the reduced prices which the company now offer to induce new trade. The Brazil patent on the Bell telephone is owned by this company, and it also owns the magneto bell and other inventions of Watson, Anders, Fuller and others in South America, owned in the United States by the American Bell Telephone Company, which latter company sells its instrumeuts exclusively to the Tropical American Telephone Company. Mr. Charles W. Jones, treasurer, has just been elected president of the New England National Bank, Boston. Mr. J. A. Derrom, who spent Christmas in the States, has just returned from Venezuela, to order a new multiple switchboard for the Caracas exchange. The Tropical American Telephone Company have issued a new and comprehensive catalogue, fully illustrated and descriptive of the complete telephonic outfit, from the transmitter to a push button, and containing a full list of reduced prices, which all export houses should avail themselves of immediately.

Brookline, Mass.—The Holtzer Cabot Company, of Boston, have just completed a very unique installation in the magnificent stables of Mr. William F. Wells, Brookline. Mr. Wells gave this week a barn-warming party in the stable, at which there were present some 700 guests, and the electric light fittings for the occasion were most elaborate and effective. The stable is wired for 180 lights, and a 75-light Edison dynamo has been installed. Mr. Wells has had a 75-light dynamo situated in a pump room, with a set of storage batteries, for the purpose of lighting his house. This plant will be removed at an early date to the stable, where the new dynamo is installed. In the stable were most beautiful temporary decorations of all kinds, and the entrance to the barn, which has a clear open height of 75 feet, with galleries, was decorated with festoons of corn, with incandescent lights intermingling, to give as much as possible the appearance of a barn. With the number of extra lights in the barn, it was necessary to utilize every particle of the current. The batteries, which had been charged in the daytime, supplied part; the dynamo in the pump room furnished more current through underground conduits, and the new dynamo in the stable furnished the rest, forming a rather complicated but quite successful illumination for the evening. The permanent fittings are very substantial, being made to imitate black iron, representing chains, twisted bars and other tasteful designs, and including some handsome chandeliers. The whole is in keeping with the architecture of the stable, which is probably the finest in this section of the country.

Boston's Electric Lights.—The whole problem of lighting the streets of Boston now turns upon the action of the Board of Aldermen. The daily newspapers are filled with columns of information about the proposed new system of the Westinghouse Electric Company, and also with long articles sympathizing with the Boston Electric Company. So keen is the controversy at present that on one side of the sheet of a daily newspaper may be seen all the possible arguments in favor of granting permission to the Suburban Company to string its wires and lay its underground cables, while on the other side of the same sheet may be read by the voracious public columns calling attention to the horrible dangers awaiting Boston if such permission should be granted. It is hard to imagine what the opinions of an honest Bostonian must be if he depends on the daily newspapers for an intelligent opinion. Meantime the North American Electric Construction Company have located about 500 poles in Dorchester and Roxbury, and have made application to the Board of Aldermen for permission to erect them. The station will be in the old Globe Nail Mills, near Hampton street, but nothing yet has been decided as to the power. At present provisions are being made for about 125 lamps in Dorchester and Roxbury, and the lamps can either be run in series or be run from converters. In these districts probably all the lamps will be in series for street lighting, though for mercantile purposes it may be found judicious to introduce converters, so as not to bring the high tension wires inside the buildings. The North American Electric Construction Company, of Pittsburgh, which will do the work, and whose electrician, Mr. Spencer, is now in Boston, is a new company and is the outcome of the reorganization of the Marr Construction Company, the Keystone Construction Company, of Pittsburgh, and the Washington Carbon Company, with a capital of $500,000. Mr. F. S. Marr is president; Mr. H. M. Doubleday is manager of the construction department; Mr. E. H. Wells, general business manager, and Mr. T. Spencer, chief electrician. A. C. S.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 Mallers Building, Chicago, Jan. 25, 1890.

The Boulder, Colo., Electric Light Company have just started a 100 h. p. Ball engine.

The Marion Steam Shovel Company, of Marion, Ohio, have purchased a 25-light Schuyler arc plant.

A Southern Electric Club.—The electrical fraternity at Atlanta, Ga., are forming an electric club.

Georgetown, Ky.—The Blue Grass Cordage Company will receive quotations on a 100-light dynamo.

Pendleton, Ind., will shortly have a glass tube factory to manufacture tubing specially designed for conduits.

Mr. H. P. Lucas, of New York, has been talking up the merits of K. K., and dining at the club rooms this week.

Mr. J. W. Phinney, Electrician of the American District Telegraph Company, Minneapolis, dined at the club rooms recently.

The Buffalo Brewing Company, of Sacramento, Cal., have recently put in an electric plant operated by a 35 h. p. Ball engine.

Mr. H. A. Glasier, vice-president of the Jarvis Engineering Company, Boston, has been a welcome visitor in the West during the past week.

Mr. J. W. Marsh, of the Standard Underground Cable Company, Pittsburgh, was entertained at the club last week by Mr. Fred. Degenhardt.

Mr. Geo. H. Roe, manager of the California Electric Light Company, was slightly injured lately while extinguishing a fire that threatened to destroy his residence.

Mr. H. Ward Leonard, general manager of the United Edison Company, New York, was in Chicago this week on a flying business trip, and was warmly welcomed by all.

Mr. Herbert Wadsworth, president of the Central Thomson-Houston Electric Company, Cincinnati, is in Chicago, and will probably change his base of operations before long.

Minonk, Ill.—The Minonk Electric Light and Power Company has been formed to furnish light, heat and power; capital, $15,000; incorporators, M. L. Newell, A. B. Knipp, and G. W. Weber.

The Battery Electric Company has been incorporated at Chicago to do an electrical manufacturing business; capital stock, $100,000; incorporators, F. Meech, E. D. Sackett and B. F. Ryder.

Mr. W. B. Pearson, manager of the Chicago office of the Ball Engine Company, has sold two Ball engines to the city of Chicago, for use in the electric plant at the House of Correction.

The Fidelity Electric Light Company has been formed at Chicago to establish and maintain an electric light plant; capital, $15,000; incorporators, G. M. Morgan, F. A. Shoemacher and J. N Snyder.

The Macomb Electric Light and Gas Company, Macomb, Ill., has been formed to furnish light, heat and power; capital, $25,000; incorporators, Charles Ketteron, H. W. Cummings and J. N. Rume.

The Municipal Light and Power Company has been formed at Chicago to furnish light, heat and power; capital, $25,000; incorporators, E. B. Preston, Hartwell Kendall, and O. C. Mackenzie.

The Tunnel Copper and Brass Works has been formed at Chicago, to manufacture and deal in copper and brass goods; capital stock, $20,000; incorporators, A. W. Balkey, E. E. Gray and A. H. Eastman.

Mr. W. A. Hoffman, editor of the Fort Worth, Tex., *Gazette*, was entertained at the club rooms on Saturday last by Mr. Fred Horne. Mr. Hoffman is a firm believer in the great future awaiting electricity.

The American Electric Motor Company has been formed at Chicago to manufacture and sell electric motors for street cars, etc.; capital, $1,000,000; incorporators, R. G. Geister, J. W. Adams, and Louis M. Hopkins.

The Columbia Electric Company, Chicago, has been formed to do a general electrical business and to control certain patents; capital, $1,500,000; incorporators, A. P. Willoughby, N. H. Hanchet, and H. C. Hunsderger.

The Rockford City Railway Company, at Rockford, Ill., has been organized and incorporated to construct and operate a street railway; capital stock, $50,000; incorporators, H. W. Price Anthony Haines and Levi Rhoads.

Angola, Ind.—The Angola Schuyler Electric Light Company started its plant this month. The advent of electricity created great excitement in the little town, and the entire stock of the company was immediately subscribed.

The National Railway Company, of Illinois, held their meeting in Chicago on the 21st inst., and elected officers as follows: President, C. B. Holmes; vice-president, C. L. Hutchinson; treasurer, Frank W. Smith; secretary, Edwin G. Foreman.

The Standard Carbon Company of Cleveland, O., are taxed to their fullest capacity in the endeavor to keep up with their orders, although they can turn out 87,000 finished carbons per day, which speaks highly for the excellent quality of their goods.

The Cross Primary Battery Electric Light and Manufacturing Company has been formed at Chicago to furnish light and power under certain patented processes; capital stock, $1,000,000; incorporators, E. D. Cross, W. V. Griffin and F. C. Rutan.

The Northwestern Electrical Supply and Construction Company, of Seattle, Wash., have recently furnished the Ellensburg Electric Light and Power Company with a Thomson-Houston plant. The steam plant, which is of 100 h. p. capacity, is furnished by the Ball Engine Company.

Boonville, Mo.—A city election has just been decided in favor of a contract with the Boonville Electric Light and Power Company to light the city for 10 years. The company will install a

plant as soon as possible, and has the cash in hand for it. The company will need two 50-light arc dynamos, 500 incandescent capacity, and 100 h. p. engine and boiler. The officers are: J. Cosgrove, president; W. Johnson, vice-president; J. F. Gruelich, treasurer, and C. C. Bell, secretary.

Julius Andrae, of Milwaukee, has secured the contract for the installation of a 600-light incandescent plant of the Mather system, with Payne engine, in the Val. Blatz Brewing Company, Milwaukee. Mr. Andrae is also wiring the residence of Mr. E. J. Tappings for 48 incandescent lamps.

The Belvidere, Ill., Electric Light Company, operating 35 arc lights and 450 incandescents on the Sperry system, have now increased their capacity by the addition of a 750-light Westinghouse alternating current machine, that is being installed by Philip Price Barton, of the Chicago office.

Mr. Louis R. Sassinot, of New Orleans, has secured the right to construct and maintain the necessary circuits required in the operation of a writing telegraph and telephone system, with permission to use the pole lines of the Louisiana Electric Light and Power Company till the iron towers are ready for service.

Mr. Fred. Euphrat, of San Francisco, is reported to have organized a stock company for exploiting a "nickel in the slot" device that furnishes a view of a panorama, some sweet music, and that indicates your weight and height, all by means of electrical apparatus, the current being furnished from storage cells.

The Wanamaker International Car-Scale Company has been organized and duly incorporated at Indianapolis, Ind., with a capital stock of $200,000, in shares of $50, by John W. Chipman, Harry E. Drew, Henry Jameson, Charles B. Wanamaker and Albert G. Cox, of Indianapolis, and Henry Gross, of St. Louis.

The Milwaukee Electric Club held a meeting last Thursday evening, at which it was decided to duly incorporate the club under the State laws. Rooms have been secured in the new Plankinton Building, corner of Second street and Grand avenue, where the club will hereafter meet, and where Prof. O. J. Rogers will read a paper at the next meeting.

Webb City, Mo.—It is reported that capitalists are again agitating the question of introducing electric power in Webb City and Cartersville, to operate the appliances used in the lead and zinc mines in that section. The mines in Webb City alone turned out, during 1889, 62,188,498 pounds of zinc ore and 4,814,966 pounds of lead ore, having a total value of $885,044.

Col. J. H. Shay, of the Charles Munson Belting Company, Chicago, has secured the order for 100 feet of 42-inch and 300 feet of 12-inch leather belting for the extension of the Peoria City Railway Company, and has also secured an order from Samuel Andrews, of Cleveland, for an additional 200 feet of 18-inch belt, making a total of 600 feet supplied to Mr. Andrews.

The Manitou & Pike's Peak R. R. Co. (cog wheel) are nearly done grading, and the road will probably be in operation by the time the season of travel sets in. The road is eight miles long, and will be lighted its entire lengthby arc lights, with a marine projector on the summit. Mr. Wm. Long has the contract to install the plant, and will use the American system.

The Chicago Edison Company held their annual meeting on the 21st inst., at which J. W. Doane was elected vice-president and F. S. Gorton secretary and treasurer. The following directors were elected: R. T. Lincoln, J. W. Doane, A. F. Seeberger, John B. Drake, E. L. Brewster, R. C. Clowry, F. S. Gorton, A. A. Sprague, E. M. Phelps, Byron L. Smith, Lambert Tree.

Mr. F. W. Horne, of the railway department of the Thomson-Houston Electric Company, Chicago office, has closed contracts, amounting to over $200,000 since the opening of the new year. Among the contracts are those with the Fort Worth, Texas, North Side Railway Company; the North Circuit Railway Company, of Dallas, Texas, and the Shreveport, La., Railway Company.

The Hudson Electric Light Company, Hudson, Mich., started its plant about the first of the month, under a thirty days' trial by the Schuyler Company, from whom the electrical machinery was purchased. With the exception of some slight delay owing to the blowing out of a handhole plate on the boiler, everything has been running with perfect satisfaction, and the people are well pleased,

Burlington, Ia.—The Burlington Electric Light and Power Company is making large additions to its plant, for which it has just secured a new site, the present buildings being used as offices and repair shops. A new 100 h. p. engine has been put in, and Fawcett boilers will be added. The company will have its own repair shops, and will do general repairing and manufacturing up to the extent of its facilities.

Mr. Wm. R. McKee has been appointed manager of the New Orleans branch of the Charles Munson Belting Company, of Chicago, and is fully equipped both with a full and complete stock, and with a competent and reliable staff of workmen, all of whom were brought up within the parent factory, to care for any orders that may come to him. Already the warehouse at No 42 Union street is becoming the rendezvous for intending purchasers of high-grade belting.

Mr. S. S. Leonard, of fuel oil fame, has resigned the position of general manager of the Minnesota Brush Electric Company at Minneapolis, and has accepted a position with the Hill Clutch Works of Cleveland, Ohio. Mr. Leonard's headquarters will probably be in Chicago, and his many friends will be glad to learn that he is still to remain in the West. The Hill Clutch Works are to be congratulated on having secured the services of a gentleman so experienced and capable as Mr. Leonard is.

The John Morris Company, Chicago, have sent a letter to their patrons from which the following is extracted: "The explosion of our boilers on the 10th inst. has made it necessary for us to put in a 40-horse power Thomson-Houston electric motor. We were disabled to such an extent by the accident that we were unable to run Saturday (the 11th inst.), but having put in the largest electric motor ever put in for such a purpose, we have our machinery all running, and assure our customers that we will take care of their orders with as much dispatch now as before the accident."

An Electrical Lantern.—The San Francisco fire department are trying a special form of lantern, containing three "5-S" E. A. cells and two 3 c. p. incandescent lamps placed in front of a reflector, the entire equipment weighing about ten pounds. It furnishes a clear white light that cannot be extinguished by smoke or gases; will not cause explosions; and will furnish light for five hours on one charging. So satisfactory has this lantern proved that it is now proposed to equip the trucks and engines with electric head lights, using 20-candle power Bernstein lamps and seven cells of the "7-M" type, one charging of which will furnish light for about eight hours.

A Proposed Electric Railway.—The Chicago *Tribune* says: "There is good authority for stating that responsible capitalists and property owners are planning to construct an electric motor railway from the junction of Colorado avenue and West Forty-eighth street south on the latter street to Ogden avenue, and thence west to Riverside, where a turn is proposed toward the Stickney tract. Such a line would pass the Grant Locomotive Works' purchase and go through good territory now rapidly developing. Just how far the plans of the proprietors of this road have gone is not known, but it is claimed that matters are progressing favorably."

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$290@$295	Cumberland	$ 58@ $60
Central Union	59@ 60	Wisconsin	115@ 117
Michigan	98@ 99	Bell of Missouri	140@ 145
Great Southern	30@ 32	Iowa Union	25@ 28
Colorado	38@ 40	Missouri and Kansas	50@ 55
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$80@$81	Chicago Edison Co	$104@$108

A Smart District Messenger.—That the average district messenger boy is a creature of marvelous construction and disposition, whose ideas of the lapse of time are wild and indefinite, is a fact that remains undisputed, and is made the subject of humorous comments. But one boy in the employ of the Lincoln District Telegraph Company, at Lincoln, Neb., has demonstrated his ability to cope with ordinary emergencies. Having been sent to the depot with a message for a gentleman about to leave on a train, he arrived just as the train was pulling out. But he did not propose to lose his man, so jumping on the rear car he pulled the bell rope, stopped the train, found his man and got off just in time to miss the assistance the brakeman was about to offer.

The Chicago Electric Club, at their regular meeting on Jan. 20, listened to an interesting paper read by Mr. Foreé Bain on the subject of "Experience as the Best Teacher in Electrical Engineering." As usual, but a limited number of members were present, thirty-one being the total number, and the majority of these were the workers who are always present and ever endeavoring to advance the interests of the club. It is understood that the meetings will be called to order promptly at eight o'clock hereafter as formerly, and thus encourage the attendance of members living in the suburbs. Treasurer Terry reported a balance of $180.93 on hand. Among the late visitors to the club rooms have been Arthur H. Chester, of Boston; C. A. Daigh, of St. Paul; R. C. Rhodes, of Minneapolis; J. J. Dickey, of Omaha; Jno. C. Leggett, of Detroit.

Protest of the Postal Telegraph Company.—In a bill filed in the Circuit Court the Postal Telegraph Cable Company asked for an injunction restraining Collector Frank E. Barnard, of the town of South Chicago, from selling its property or in any way attempting to collect what the company calls an unjust tax. Incorporated under the laws of the State of New York, the company asserts that it holds its franchise and capital stock by warrant of its corporation license, and has no liability to any town municipality for such ownership. In spite of this it is said the stock and franchise have been assessed at a valuation of $5,000 by the South Town Assessor, and now Barnard claims $268 as a tax on this. The company pleaded that its only taxable property in the town was the telegraph line and appurtenances, valued in all at $5,400. The company says it offered to pay the collector the tax of $289 due on this, but Mr. Barnard claimed all or nothing.

The Charles Munson Belting Company, located at 28 to 36 South Canal street, Chicago, are manufacturers of the celebrated Eagle brand of leather belting. Twenty-five years ago Mr. Munson came from the East and started in a very small way manufacturing leather belting. The growth of this establishment is only equaled by his grit and push. Advancing from small beginnings this corporation now has a factory unequaled in its facilities or amount of its productions in the United States. Their trade is confined exclusively to consumers, manufacturing and adapting each belt for its special work. The results exhibit the scientific principles underlying the whole manufacturing department—one class of hides, one tannage and purely oak, with employés that are skilled in their varied departments. Their method of obviating the stretch and their method of securing the laps, simply dependiug upon the cement, discarding rivets, pegs, and all other methods of fastening, produce results heretofore unattained. The entire power of the belt is secured, it is rendered noiseless, and, in short, is of the highest possible standard of excellence. The high indorsement their electric light belting has received from nearly every prominent electrician indicates how thoroughly they have solved the problem of manufacturing a belt that will give perfect satisfaction under all ordinary conditions. Their trade extends the world over, and the Munson belt can be found in England, in Cuba and in South Africa. Branch houses fully equipped for handling an extensive business have been established in New York, New Orleans, Pittsburgh and San Francisco. Mr. Munson, in referring to business prospects, says: "The spring trade has already opened with unusual vigor far in advance of the season. Heretofore we were satisfied if the orders from mills came to us in March, but already they are arriving. Yesterday we received an order for belting an entire mill and today a similar order for two mills, and so it has been going on. Such a satisfactory state of affairs is unprecedented in my experience, and has warranted us in renting the two great lofts adjoining our present buildings, and holding them subject to our control till next year, in order that we may have ample room at hand to care for any trade that may come to us."

Interior Conduits.—The Electrical Supply Company, Chicago, have issued a neat little circular of special interest to architects, in which they say: "Up to the present time, architects have met with serious difficulties in specifying the manner of running electric wires in buildings, for the reason that the methods employed in the various systems of incandescent lighting are different, and this, of course, compels an accurate knowledge of each, as no general method of wiring has been possible heretofore. Again, the architect is referred to for the approval of all bills before they are finally paid, and in placing his signature upon a bill for wiring, he has sanctioned a charge of whose justice he can know but little. We show here a complete system of interior conduits in which to run electric wires for incandescent lights. By its use, the architect is able to plan a thorough and comprehensive system of conduits throughout a building, which will be not only low-priced, but thoroughly reliable and easily accessible, and can be laid beneath plaster in the same manner as gas or water pipes. The system consists primarily of a highly insulating and weather-proof tube, made in various sizes from ¼ to 1¼ inches inside diameter, and in uniform lengths of 10 feet. When these conduits are laid throughout a building, they form a convenient and permanent moisture and electrically fire-proof channel, through which the electric conductors may be inserted by means of fishing wire, or withdrawn, if necessary, without inconvenience or injury to wall or decoration. All danger to property by fire from electricity is obviated, as the high insulation will prevent any dangerous leaking of the current. The tube leads to junction boxes in which porcelain cut-outs are placed, and these boxes may be located where most desirable. The covers of the boxes are made either ornamental or perfectly plain, and as they are flush with the wall they may be decorated to correspond with it. Branch junction boxes are placed where branches are required, and which allow ready access to any desired section. This system has been approved by the Board of Fire Underwriters in New York, Boston and Baltimore, and will meet with the approval of all boards when this system is brought to their notice. The prices of the tubing are extremely low, and when the ease and readiness with which wires may be laid are considered, the expense is not greater than that attending the old methods of wiring." This system of conduits is now being placed in a large number of handsome buildings in course of erection in Chicago and other Western cities. F. De L.

CINCINNATI, O., Jan. 20, 1890.

Captain G. N. Stone said, among other things of interest, in his annual report to the stockholders of the Cincinnati Bell Telephone Company: "During the year ending Dec. 31, 1889, we have sent and received 95,870 toll messages to points outside of this city. A careful record of exchange messages in the Cincinnati Exchange District has been kept, which shows this company has handled for its subscribers during the same time 16,640,715 messages, or an average of 13 calls per subscriber per day. This will prove of interest in illustrating the magnitude of the business and the low price per message received. No service except that of the United States mails approximates in convenience and cheapness that represented by the business handled by this company at an average cost to its patrons of only a fraction more than one cent a message including answers thereto. Many of our business subscribers use their telephones more than 100 times per day, which reduces the cost to them to so small a fraction of a cent per message that it cannot be estimated."

A Prosperous Company.—That old established and well-known house, the Jones Bros.' Electric Company, are now nicely situated in their own four-story and basement building at 28, 30 and 32 Court street. Their extensive power and lighting plant is in the basement, and includes a 200 h. p. Hamilton-Corliss engine and a 100 h. p. Beck engine, while an additional engine of each make is contracted for. With the aid of a line of shafting these engines will drive Mather generators having a total capacity of about 800 h. p., the current being employed in driving motors for users of small power, and also for incandescent lighting within a radius of half a mile, the respective circuits being separately carried on a strongly built pole line. For generating steam slack coal is used, costing $1.75 per ton, delivered. The first floor contains the convenient offices and the large retail department. The second floor is filled with heavy supplies of varied character, suitable for all branches of the electrical industries. In the line of insulated wires they are carrying a good stock, their sales of Simplex wire of one size exceeding over 50 miles last month. The third floor is rented to a printing company, who operate all their machinery with the aid of electric motors. On the fourth floor is the manufacturing department, containing improved lathes, dies and other machinery. A section of this floor contains the plating department and the brass foundry, quite a business being done in the line of small brass castings for furniture fixtures. Above this floor a room has been built for the drafting department, where plans, sketches and blue prints are prepared, and where a wood engraver is also occupied; all of which is of valuable assistance to the experimentalist, and it requires but a moment's visit to these upper floors to ascertain how thoroughly equipped they are for the perfecting and building of models. The repairing, rewinding and balancing of armatures is also a specialty. In remodeling the building the company made it as strong as possible and added an automatic sprinkling system and other improvements that enabled them to secure a low rate for all the insurance desired. A very pleasant feature concerning the personnel of the company is the fact that the entire capital stock of the company is paid up, and owned principally by the employés and officers.

The Cincinnati Electric Light and Power Company's Station, having a frontage of 100 feet on Broadway, will be entirely roofed in and floored over by the time this note reaches your readers. Mr. N. C. Powelson, the superintendent of construction, states that the machinery is at hand and will be placed in position as rapidly as the construction of the building permits. A line of counter shafting, 124 feet in length, will be driven by two 500 h. p. Corliss engines, assisted by two 100 h. p. and one 200 h. p. compound condensing Buckeye engines. Twenty-two Thomson-Houston arc machines, of fifty lights capacity each, are being received, as well as ten 1,300-light alternating machines. In the operation of this plant a prominent feature will be the generation of fuel gas under the M. V. Smith system, for use in making steam. According to Mr. Smith's statements, the company will effect a saving of over 66 per cent. in their fuel account by the use of his system, while he has given ample bonds to cover any loss that may occur through a failure on the part of his plant to give perfect satisfaction. Mr. Powelson states that it will be but the work of an hour to change the furnaces over to consume coal should such action appear necessary. In either case the company proposes to use the refuse culm coal, that costs less than $1.25 per ton delivered in the furnace room. The removal of the ashes will cost 7½ cents per single cartload. For the condensers the water will be taken from the Miami canal passing the station, a suitably sized pipe being driven underneath the bank, and a contract made with the department for all the water desired, at a cost of only $150 per year. Owing to the amount of fibrous material held in suspension in this water it will be passed through a National filter having a capacity for clearing 65,000 gallons in the twenty-four hours. This canal water is impregnated with muriatic acid, which affects its value for boiler use, so the company will bore a series of wells in the ground adjoining the station, as a neighboring factory has secured an excellent quality of water at a depth of only 80 feet, with a steady flow of over 2,000 gallons per hour. To purify this water they will use four of the large live-steam purifiers made by the Stilwell & Bierce Manufacturing Company. The open weather thus far enjoyed has favored construction work and permitted of rapid progress being made.

The Cincinnati Street Railway.—Mr. Elmer P. Morris, who is superintending the operation of the overhead Thomson-Houston electrical system for this company, in chatting about his line, said: "A teamster never gets over the dread of being struck by a grip car, and will endeavor to keep as far away from the track as possible, while it only requires a week's experience to convince him that there is nothing evil about the motor car, and he will take time in leisurely turning out for us. I presume that this is due to the perfect and instantaneous control we have in the motor over the grip car, and the same feeling of a greater degree of security and comfort has been referred to by leading citizens when comparing the grip with the motor car, where equally good construction is secured. Our road is far from being a level one; in fact the line extending two miles out on Colerain avenue has not a foot of level track. One grade of three per cent is 1,800 feet long; one of four per cent. is 800 feet in length; and then there is a heavier grade of some 1,300 feet. This distance of two miles is easily covered in 11 minutes in all sorts of weather, and this, notwithstanding the fact that owing to the class of traffic on the street the rails are almost constantly covered with a greasy, slippery mixture, that in the past has proven unusually destructive of horseflesh, owing to the loss of traction. We have a double circuit running the entire length of

the line and thus cause no trouble to the telephone system. You know that in case a fire should occur along our line the firemen would probably cut the wires and thus bring all the motor cars to a standstill. To prevent such a loss of time and to avert all possibility of danger from the fallen wires, now I propose to perfect a system of line switches to be put in all along the line at a distance of, say, 500 feet apart. These switches will be so constructed that the current may be turned off by the firemen, who will be provided with keys to unlock the switches. By this means any desired section of the main line may be rendered 'dead' and consequently harmless for the distance of a block, or in fact as many blocks as may be desired, provided enough of the switches are 'thrown.' The remainder of the line can be operated; hence you see, in case of trouble down town, the cars could be run down to the scene of the fire and run back without interference. We have not lost a moment's time since August 6. Our engines consists of two Ball, each of 150 h. p., and one Hamilton-Corliss of 300 h. p., and in addition to furnishing current to eight motor cars drawing one ton car each, we also operate 380 incandescent lamps and a 20 h. p. Queen City motor used in driving a feed cutter, etc."

A Model Pole Line.—Mr. George F. Card, superintendent of the Cincinnati Electric Light Company, is building an overhead circuit that can be profitably copied by all new companies. Selected white oak hexagonal poles that rise 40 feet clear of the sidewalk are placed in narrow holes 6 feet in depth, and the vacant space is filled in—not with dirt, but entirely with macadam. Wherever the solid stone flagging covers a section of the basement, no hole is made, other than four bolt holes, by means of which a tapering cast-iron thimble 4 feet in height and weighing 600 pounds is securely bolted to the sidewalk. The pole is placed within the thimble and the surrounding space filled with melted sulphur, which allows for any change of temperature as well as preventing the absorption of moisture. Thimble and pole are painted with two coats of a neat red color to a height of 6 feet, then a 12-inch band of black, and the remainder clear white. Heavy cross arms having four, six or eight holes are used, double arms are placed at each turning point, while every cross arm is double braced, and every corner pole strongly guyed with ⅜ inch galvanized steel rope and swiveled turn buckle to a 10 foot oak post placed at an angle 8 feet in the ground. The pins are of split oak, the corner pins being bolted to the cross arm and all glass insulators are of the heavy double-petticoat deep groove form. No. 6 Simplex heavily insulated wire is now being strung, and where it comes nearer than 3 feet below the telegraph or telephone wires the latter are raised to the proper height, the respective company furnishing the poles and material and Mr. Card the necessary labor. General Hickenlooper instructed Mr. Card to spare no expense in constructing a strong, well-built line, of the best material that money will buy, in order that the company could once for all determine whether overhead circuits could be safely and economically operated, irrespective of what others may claim. Mr. Card said, in referring to underground systems: "In a short time we shall be carrying on a series of experiments to determine the best method of underground work, and we are perfectly willing and stand ready to place our wires underground the moment a safe, practical method is demonstrated." This overhead pole line is so perfectly constructed and so neat in appearance that the Board of Public Works approved the following report and recommendation: "The Committee on Light recommends that in the matter of erecting electric light poles on Fourth street the Cincinnati Electric Light Company be authorized to proceed with the erection of poles under their permit and the ordinances, and that when said line of poles is erected, the Brush Company be required to remove the poles now on Fourth street, and to occupy the line of poles of the Cincinnati Electric Light Company."

PITTSBURGH, Pa., Jan. 24, 1890.

Pittsburgh's Overhead Wires will all be put under ground within a year. Chief Biglow, department of public highways, representing the city, informed the officers of the telegraph, telephone and electric light companies a short time ago that the people have demanded, in the interests of safety, that the overhead wires must come down. All of the companies promised that they would make the change within a year.

Edison plants are no longer a novelty in this vicinity. Two years ago Western Pennsylvania and the entire State of West Virginia had one isolated plant of 75 lights; to-day there are about 11,000, not including the central station illuminating companies. Among the recent contracts closed by Stern & Silverman, agents for this district are: Clarksburg Electric Light and Power Company, Clarksburg, W. Va., 550 incandescents; Weston Electric Light, Power and Water Company, Weston, W. Va., 400 incandescents and 20 arcs; Pittsburgh Plate Glass Company, Creighton, Pa., 800 incandescents; Latrobe Steel Works, Latrobe, Pa., 100 incandescents; A. Hersch, Meyersdale, Pa., 20 incandescents: J. S. Graves & Co., Meyersdale, Pa., 45 incandescents; J. Kaufmann & Bros., Pittsburgh, Pa., 45 1,200 candle-power arc plant; South Easton Electric Light Company, South Easton, Pa., 550 incandescents.

The Westinghouse Electric Company, which has its main plant almost in the heart of Pittsburgh, has, it is reported, decided to move out of the city. It will erect, as soon as possible, immense new works near Brinton on the main line of the Pennsylvania Railroad, about twelve miles from Pittsburgh. This removal is made necessary on account of lack of space and the cost of enlarging a plant in the city. The present buildings are to be sold and will yield $500,000. This money will be used in the construction of the new shops, which will occupy a plot of fifteen acres. It is the purpose to lay out and build up a new borough surrounding the plant, as is being done at Wilmerding, several miles distant, where the new Westinghouse Air-Brake Works are nearing completion. The electric company since a year ago has increased the number of its workmen from 600 to 1,300, and these, with their families, will give the new town a population of about 5,000 souls. The company in 1889 set up 134 central stations in Europe and America, with an aggregate of 234,250 lights. This represents a business of between $4,000,000 and $5,000,000. The new town will have connections with the Pennsylvania and Vanderbilt systems of railroads.

The North American Construction Company.—An important consolidation of electrical interests took place a few days ago. At a joint meeting of the stockholders of the Keystone Construction Company, the Marr Construction Company and the Washington Carbon Company, it was decided to amalgamate the interests of these concerns and call the new organization the North American Construction Company. The new company went into effect on January 21, with head offices in the Westinghouse Building, in this city. The officers of the North American Construction Company are James S. Humbird, president; F. S. Marr, vice-president and general manager; H. M. Doubleday, general superintendent, and E. H. Wells, general agent. The company will do exploiting and electric construction both for central stations and railway work; and also build, lease and operate central station plants. The Marr Construction Company has been in existence for six years, being originally organized to do the construction work for the Edison Electric Company. About four years ago, however, the company commenced to do construction work for the Westinghouse Electric Company. The Keystone Construction Company was established a few years ago as an adjunct of the Westinghouse Electric Company, for which it has done the construction work ever since. The Washington Carbon Company was organized by Mr. J. S. Humbird about a year ago for the purpose of manufacturing carbons for general electric use The new company employs about four hundred men and has a capital stock of $500,000.

DETROIT, Jan. 25, 1890.

The Detroit Motor Company., of this city, shipped a 7½ h. p. motor to Boston, and a 10 h. p. motor to Chicago, on telegraphic orders received last week. This company received a diploma for a motor and for the best battery for motor purpose from the Texas State Fair and Dallas Exposition.

The Cadillac House, Detroit, appears to be the headquarters of the electrical fraternity, judging from the number constantly stopping there, all of whom are attracted, no doubt, by the unequaled cuisine and perfect service rendered in that dainty dining room. Happy is the traveler who can arrange to spend his Sunday at the Cadillac.

A City Plant for Detroit.—Mayor Pingree's suggestion that the city go into the electric lighting business for itself some time in the future is one to let lie on the table for a good long time. A mighty good principle of government is that the municipality or State shall reduce the scope of its activities to the minimum. Either should keep out of business it can get done for it by competitive contract. From the business side of it, it is questionable whether the city could make money out of the public lighting alone. If it undertook private lighting in competition with private producers it would be very properly estopped.—*Detroit News.*

A Primary Battery.—The Parrish Bros., 93 Shelby street, Detroit, have devised a primary battery that gives promise of excellent results. Baraga graphite and commercial zinc are the electrodes, while the electrolyte is a solution of common salt. The potential secured is only 1.2 volt per cell, but the quantity of current is very large, and fair results have been obtained in the matter of incandescent lighting. As the graphite can be now purchased at $10 per ton, and the exhausted electrodes can probably be sold for other uses, Parrish Bros. expect that the cell will replace many storage cells now in use for heavy work, and they are arranging to place the battery on the market.

Mr. Frank B. Rae, of the National Traction Company, Detroit, will probably be at the convention in Kansas City, and will proceed from there to East Saginaw, to be present at the opening of the extensive electric railway line his company is now building to connect the two Saginaws. Possibly a number of the delegates will accompany him on the trip. Four 80,000-watt compound Rae generators are in use on this line, belted to a line of shafting driven by Bartlett-Corliss double tandem compound condensing engines. Mr. Rae stated that when completed there will be over seventeen miles of track, and that one of the motor cars now in service had already traveled 1,546 miles without requiring the slightest attention or the apparent necessity for the application of a wrench.

Mr. John R. Markle, President of the Markle Engineering Company, Detroit, is a firm believer in the continued growth and prosperity of the electrical industries, and hopes that the present year will witness the enforcement of regulations permitting only the highest grade of construction work. Referring to the combinations formed by the leading parent companies, Mr. Markle said that these are merely the first steps toward still further combinations for the economical production and distribution of every-day necessities, such as gaseous fuel and electricity for light and power and heat, and that all these will soon be obtainable from one grand central station under one administration, where the highest grade of machinery, designed for the specific purpose, will be employed, thus doing away with the many inconveniences necessarily entailed by the use of coal in a thousand factories, and effecting a corresponding saving in fuel bills, and in the promotion of health and cleanliness.

DALLAS, Tex., Jan. 18, 1890.

Mr. Henry Garrett, the well-known superintendent of the Queen City Electric Light Company, of the city, has resigned.

The South Dallas Rapid Transit Railway will be in operation in a few days. Everything is completed, but matters have been delayed by the non-arrival of the trucks, which are now on the way.

Dallas has again emerged from the gloom so prevalent lately; it was unavoidable, however, as it was caused by necessary repairs being made to the water works. The employés no doubt enjoyed their brief season of rest.

Victoria, Tex.—The electric light plant at Victoria, Tex., was started last week. The plant consists of one 650-light Westinghouse alternating machine and Erie engine. The plant is erected in a substantial manner, and started with a large number of lights subscribed for.

Fort Worth, Tex.—At a recent meeting of the Council of the city of Fort Worth, Tex., the report of the committee appointed to investigate the various systems of lighting was read. The committee visited a number of cities and recommended the adoption of the Brush and Edison systems.

Mr. J. R. Fletcher, of the Electrical Supply Company of Chicago, is making the grand rounds in the interest of his company, and spent several days in Dallas and vicinity. Mr. Fletcher is a very genial gentleman, and made many friends both for himself and the company. He left last week for California.

Queen City Electric Light Company.—The entire plant of the Queen City Electric Light Company, of this city, will be sold at public auction Feb. 4, to satisfy debts amounting to $24,000, due principally to the Fort Wayne Electric Company. The plant consists of dynamos, engines, boilers, heater, pump, 46 miles of wire, etc.

The North Side Street Railway at Fort Worth, Texas, after a series of trials with electricity have decided to return to mule power. The National Electric Traction Company, who constructed the road, claim that it is impossible to operate the road under such adverse circumstances as, poor track, rattle-trap cars and cheap labor. The resort will no doubt be to the courts.

VIRGINIA CITY, Nev., Jan 10, 1890.

The Brush Mining Plant.—A final test of the Brush electric motor plant, that operates the Nevada mill, was made last Sunday in the presence of Evan Williams, superintendent of the Nevada Mill and Mining Company, and engineers Messrs. Petit and Ross, the latter taking copious notes of every detail of the working of the plant. The result of their observations was submitted in writing and the plant was formally accepted yesterday. The plant is the largest in the world and the cost is $100,000. It consists of six dynamos of 100 h. p. each, placed on the Sutro tunnel level of the Chollar incline, 1,630 feet below the surface. These dynamos are operated by Pelton wheels placed on the same level, the wheels being driven by a volume of 187 inches of water confined in an iron pipe ten inches in diameter, leading from the surface tank to the point of discharge, 1,630 feet below. The electric power generated by the dynamos is transmitted by wires to the surface motor room, 2,300 feet distant from the dynamo chamber. The test proved that 63½ per cent. of the power generated in the dynamo chamber is delivered to the surface motors—which is 3½ per cent. more than the contract between the Brush Electric Company and Nevada Mill and Mining Company specifies. A total of 450 h. p. is required to operate the mill, which is equipped with 60 stamps, 16 pans, 10 settlers, two agitators and three sulphuret pans. Of the 450 h. p. required to operate the entire mill, the Brush electric plant furnishes 380 h. p., the surface Pelton wheel on which the volume of water required to operate the Sutro tunnel dynamo is discharged prior to passing down the incline, furnishes the auxiliary 70. The mill has been in constant operation, propelled by the electric motors, for above three months, during which it has moved with the precision of the finest clockwork.

PUEBLO, Col., Jan. 8, 1890.

The Pueblo Light, Heat and Power Company is doing very nicely. It uses the Schuyler arc lighting and the Westinghouse alternating systems, and is making the third increase in its Schuyler plant within four months. The officers are: J. D. Miller, president; J. H. Bennett, vice-president; J. O. Albert, secretary and treasurer, and C. M. Davis, manager and superintendent. The local paper says: "To day as a *Press* representative was wandering along Grand avenue his attention was attracted by the unusual activity manifested around and about the plant of the new electric light company—the Light, Heat and Power Company. Passing into this wonderful institution we were met by the superintendent, who was directing the numerous mechanics in their work for the day. To say that we were surprised at the marvelous growth of this institution is mildly expressing it. This plant has been in operation about one year, and the reporter can well remember when this company for the first time turned currents on its wires one year ago this month with the modest number of 800 incandescent lamps. During the past year they have increased twice, and the present makes the third addition. To-day this company operates over 2,300 incandescent lamps of various candle power and upward of 70 arcs. The main dynamo room contains four powerful engines, while the new two-story addition fronting on Third street will contain, when completed, four more, making a total of eight separate and distinct engines, and all within the brief space of one year. The large increase this popular company now has under course of construction is a more convincing proof of Pueblo's growth than anything that has come under the observation of the *Press* for some time. This company is simply meeting the demands of a rapidly growing city."

ST. LOUIS, Mo., Jan. 25, 1890.

Mr. David Dougherty, of the St. Louis office of the Postal Telegraph Cable Company, recently said: A glance at the table of charges of the Commercial Cable Company recalls Puck's declaration that he could put a girdle about the earth in forty minutes. There seems to be no portion of the globe where civilization has not obtained a foothold. Messages can be sent from extreme of the fixed rate to New York, and thence by transatlantic cable to Great Britain, Ireland, France and Germany, to Algeria, Morocco, Tripoli and Tunis on the northern coast of Africa for from eight cents to twenty-seven cents per word. Delagoa Bay, Mozambique, Zanzibar and the Transvaal in South Africa can be reached for $2.16 per word. There are twenty-eight telegraphic stations on the west coast of Africa, the tariff ranging from $1.45 to $2 per word. In South America, the Argentine Republic, Brazil, Chili, Colombia, Ecuador, Paraguay, Peru and Uruguay are reached from England by twenty-eight stations, the charges ranging from $1.40 to $4.70 per word. All portions of Arabia, Australia, China, Cochin China, Corea, Ascension Islands, Corfu, Corsica, Cyprus, Canary Islands, Greek Islands, Herzegovina, India, Japan, Java or Sumatra, Liberia, Persia, Phillippine Islands, Siam, are reached by telegraph direct, and telegrams are mailed from these points to all known countries. The highest price charged is $11.76 per word to South Persia. Cipher dispatches are prohibited to Turkey, both in Asia and Europe; Roumania, Tripoli, Servia and several other countries. All messages to the Orient must be written in French. It wants but a trans-Pacific cable to complete the girdle about the earth.

SPRINGFIELD, O., Jan 12, 1890.

A New Turbine Company.—A new company for the manufacture of water wheels and engines has been incorporated, with the following incorporators: Messrs. Fuller Trump, W. C. Leffel, Wm. Foos, Percy Norton and Frank Clark. The following organization has been effected; W. C. Leffel, president; Fuller Trump, vice-president and manager; Percy Norton, secretary and treasurer. The capital stock of the new concern is $100,000. W. C. Leffel and Wm. Foos are the capitalists. A member of the new concern states that they expect to erect works in the eastern part of the city. Mr. Fuller Trump and Percy Norton were formerly connected with James Leffel & Co., Mr. Trump, as manager of the water wheel department, and Mr. Norton as manager of the engine department. Mr. John W. Bookwalter, who has for years been sole proprietor of the great firm of James Leffel & Co., manufacturers of turbine water wheels and of engines, has already incorporated his concern. Mr. Bookwalter's object in incorporating the business was to relieve himself of personal attention to the business as far as possible. He is absolute owner, and has been for years of all patents, patterns, buildings, tools and machinery of the firm of James Leffel & Co. There will be no change in the Eastern office of the firm. The capital stock of the firm of James Leffel & Co. is $250,000. Mr. Bookwalter stated to-night that new machinery would be added, and the business pushed with greater vigor. Mr. Frank Bookwalter, who takes charge next week, managed the concern with great success several years.

ANN ARBOR, Mich., Jan. 16, 1890.

The Ann Arbor Thomson-Houston Electric Company has recently purchased a 650 alternating machine in order to extend their incandescent lighting. They have also added to their plant a 150 h. p. Ball engine. Their present arc machines are loaded down beyond their maximum rated capacity.

The Brush Electric Company has presented to the Physical Laboratory of the University one ten arc light dynamo, five double and five single carbon lamps, a 5 h. p. constant potential motor, a current regulator, a belt tightener, and an ammeter. Mr. Brush is himself a graduate of the university.

Electric Railway.—While work has not yet begun on the electric street railway in this city, the promoters of the enterprise have deposited in one of the city banks the forfeit money required by the city council when the charter was granted. It is hoped that something will be done early in the spring.

Ann Arbor Physical Laboratory.—Recent additions to the apparatus in electric measurements include several resistance

boxes and a high resistance Thomson astatic galvanometer from Elliott Brothers, of London; a Thomson centi-ampére; balance, made by White of Glasgow, and a 250,000 ohm box of coils from Queen & Co. H. S. C.

Racine, Wis., Jan. 15, 1890.

An Electric Time Clock service will soon be started in the city.

Street Lighting.—The city will advertise for bids for street lighting in a few weeks.

The Belle City Opera House, which will open the middle of February, will be lighted throughout with incandescent lights.

Mr. G. M. Shearer, formerly with the Badger Electric Company, of this city, has accepted the management of the Thomson-Houston station at Fort Dodge, Iowa.

The Badger Electric Co. expect to start a motor circuit soon. They are pushing residence lighting, and are introducing a number of Slattery meters for their alternating circuits.

Overhead Wires.—A committee, composed of the mayor and several aldermen, have had a conference with the representatives of the telegraph, telephone and electric light companies, to ascertain their views on the best method of clearing our two main streets of overhead wires. Some advocate moving to the back streets, and others having the wires go underground. No active opposition has been met yet, but it is difficult to predict what the outcome will be. P. H. R.

Duluth, Minn., Jan. 19, 1890.

The Duluth Electric Company have not been inactive. They have captured the city contract for 180 arc lamps, have built up a commercial circuit of 30 arc lamps, have put in a power circuit, and loaded down two more 500-light alternators and are now putting in the fourth. They have increased their power plant since January, 1889, first by a 300 h. p. Hamilton-Corliss condensing engine, and again by a 150 h. p. Buckeye engine.

Duluth Electric Light and Power Company.—There has been marvelous activity in electrical matters here during the past year. In January, 1889, the Duluth Electric Light and Power Company were running 100 Thomson-Houston arc lights and 650 a. c. lights, and the Duluth Electric Company were running a 500 light United States alternator. Since then the former company have added two more machines, uniform with their original one, and have found it necessary to order a fourth in order to keep up with their increasing business. They are now placing the foundations for a 150 h. p. engine and for a 500 h. p boiler of the Scotch marine type. They have wired several large office buildings and also the Temple Opera House. The latter is wired for 750 lights and is to be lighted from the company's station. The management of this opera house considered electricity so reliable that they made no provision whatever for other illuminants. J. H. G.

Lake Linden, Mich., Jan. 16, 1890.

The Peninsula Company.—From the Torch Lake *Times* I clip the following: "At the annual meeting of the stockholders of the Peninsula Electric Light and Power Company, last Tuesday, the following persons were elected as directors: Jay A. Hubbell, Edward Ryan, J. B. Sturgis, R. R. Goodell and Jas. H. Seager. The old officers were re-elected." The above mentioned company are rapidly pushing to completion the work at the electric light station at this place. They have a fine 100 × 50 foot brick building, which would be a credit to a much larger city, and are now placing their machinery—two engines and three dynamos, all furnished with the latest and best improvements; one for incandescent lighting of the best Thomson-Houston alternating current type and one 50 and one 30 arc light dynamo. About the first of February we shall see Lake Linden, Calumet and Red Jacket lighted from this plant. Other dynamos will be put in as soon as needed. Another year, probably, South Lake, Linden, Tamarack and Dollar Bay will also be lighted from this station.

Appleton, Wis., Jan. 10, 1890.

The Edison Incandescent Light System has four 250-light dynamos run by water power. No arc lamps are used in our city.

The Street Car Company has begun selling power to small establishments. Two 3 h. p. C. & C. motors are mounted in the newspaper buildings and one in the First National Bank for running a fan.

Electric Roads.—Appleton has two electric plants, the Edison light and the Van Depoele street car systems. The street car system has one 50 h. p. Van Depoele dynamo and a small dynamo used for exciting the large one. The plant is operated by water power. Five cars are in use, four of which are supplied with 8 h. p., and one open car with a 10 h. p. motor. The line is about three miles in length. It is provided with the overhead wire system. The motors are mounted on the front platform and thus have a somewhat awkward appearance. G. C. M.

Louisville, Ky., Jan. 8, 1890.

The Louisville Electric Light Company are at present adding a 1,500 16 c. p. alternating dynamo to their plant, making three machines of 3,000 16 c. p. capacity. Manager Gaylord reports business as being exceedingly lively.

At the New Bridge.—The Central Thomson-Houston Company are installing an arc and incandescent plant at the new bridge across the Ohio river at this point. The incandescent lamps are used inside the caissons, the arcs outside.

The Central Thomson-Houston Company have recently opened an office at 434 West Main street, Louisville, Ky., for the better accommodation of its customers, and the public generally in Kentucky and southern Indiana. Prof. Thomas H. Fearey is manager of the office and Mr. W. J. Ferris is the traveling agent.

The Gaynor Electric Company have fitted up two large show windows of plate glass, and now show their specialties to a greater advantage. The windows are beautifully illuminated at night with incandescent lamps in various kinds of globes, the effect being very pleasing.

Lima, O., Jan. 18, 1890.

Mr. J. Nolan, formerly superintendent of the Thomson-Houston plant at Toledo, O., has accepted the superintendency of the Thomson-Houston system here, vice Mallon resigned.

The Gamewell Company are pushing the construction of the city fire alarm to completion. The boxes are handsome. The workmanship is first class, with one exception. I notice they have not as yet soldered connections.

Motor Installed.—A 1 h. p. C. & C. old type motor, has been put in a seed establishment here to run a clover and timothy seed cleaner. Originally this was turned by man power, and the seed was lifted up and put in the machine. Now the motor does it all. It runs the grain carriers or elevators and it cleans the grain as fast as it feeds it. The proprietor was going to try steam, gas and water and finally drifted on to electricity. He pays $10 a month for service from 7 A. M. to 7 P. M. 1 h. p., and says you can't buy his motor for anything, if he can't get another.

Burlington, Iowa, Jan. 7, 1890.

The Burlington Electric Light and Power Company have now in progress an extension of their works which will double the capacity and increase the convenience of operating. The new plant is now being erected upon a more central site. It will be completed, and set in operation to do the work of the present plant which will then be moved to the new location. They have already placed on its foundation a 100 h. p. automatic engine and have the foundations laid for the accompanying boiler, which is being made here. When their plans are consummated they will be prepared to deliver light and power either night or day. They have selected a site quite central for municipal and domestic lighting and power, and very convenient for commercial work. The dynamos to be used have not yet been decided on positively, owing to some uncertainty as to the requirements for the respective kinds of service.

ENGLISH NOTES.

(From Our Own Correspondent.)

Jan. 10, 1890.

Increase of Central Stations.—During the year the number of central lighting stations at work in the United Kingdom has nearly doubled, while electric traction has come into operation on three additional lines. Outside of electric lighting, however, perhaps the most marked development has taken place in the demand for electrical mining plants and electric launch plants. Messrs. Immisch & Co., who make a specialty of launch and mining plants, have been overwhelmed with work during the past twelve months. Messrs. Immisch's fleet of launches on the Thames has proved a decided success, and in July and August the demand was so great that the resources of the company were taxed to their utmost. Next summer it is intended to largely increase the number both of launches and of charging stations. But wherever we turn the increased popularity of the electric light, the large number of central stations which have come into operation, and of central stations which will shortly do so, has kept all our electrical engineering and manufacturing firms fully employed, great difficulty in many cases having been experienced in performing contracts within the proper time. With the prospect of numerous central stations being started in the provinces, and of a large increase of tramways worked by electricity, the outlook for the coming year is most encouraging.

Telegraphy and Telephony.—In the telegraphic and telephonic worlds the year 1889 has been by no means uneventful. At the beginning of April the government took over the cables connecting this country with the continent. The price paid for the cables gave rise to much lamentation among the shareholders of the submarine cable company, who, but for the fat reserve fund which had been built up, would have received but a small amount of hard cash in return for their shares. The question of the amalgamation of the three leading telephone companies in this country, which had for some considerable period been on the tapis, was finally brought to a head in May, not without, however, what may be called a warning as to the possible consequences, from the Postmaster-General. The United Telephone Company and the Lancashire and Cheshire Telephone Company no longer exist, and the territory of the National Company now covers the whole of Scotland and all England from the Tweed to the Thames. Much was expected from this powerful combination in the way of increased trunk communication and improvement in the working of the London system. The warnings of the Postmaster-General are, however, it would seem, having their effect, and in reply to inquiries as to why the London system still remains very much what it was, and as to why the much-talked-of London and Birmingham trunk line is still in the clouds, we are told that, in view of the present state of uncertainty as to the intentions of the Postmaster-General, it would be unadvisable for the National Telephone Company to lay out much capital on its trunk extension or exchange improvements.

1889 in England.—The past twelve months will long be memorable in the annals of electric lighting in this country for an outburst of electrical activity rivaling the great railway mania of 1846, and exceeding the expectations of the most sanguine. At the beginning of the year this activity was chiefly concentrated on the metropolis, where some eight or nine companies were competing for the lighting. The necessity for settling this important question upon some broad general basis, the novelty and variety of the systems proposed, the conflicting and, in many cases, the unreasonable demands of the vestries, made it necessary for the Board of Trade to institute an inquiry into the whole question. This inquiry opened on April 3, and extended over eighteen days. The questions of finance, system, high and low tension, battery distribution, competition, etc., etc., were thoroughly threshed out before the Board of Trade Inspector, Major Marindin, R. E. Among the witnesses examined was Sir William Thomson, who, in spite of an able cross-examination by the legal advocate of low tension, Mr. Fletcher Moulton, Q. C., refused to be inveigled into condemning Mr. Ferranti's 10,000 volts. The Deptford scheme was, he admitted, a gigantic experiment, but he saw no reason for its failure. At the end of May Major Marindin published his lengthy and able report, and the most important of his recommendations (one which has been hitherto rigorously adhered to by the Board of Trade) was that for the present only two companies should be given concurrent powers over the same area, and that wherever possible, only one of these companies should be a transformer company. Major Marindin's report was, however, only one stage in the process of obtaining powers for lighting London. On July 16 the bills embodying the proposals of the various companies came before a select committee of the House of Commons. They then went before a select committee of the House of Lords, and finally, at the end of August, received the royal assent, statutory powers being granted to eight companies. As my recent letters have testified, the companies who obtained powers set to work immediately to lay down their mains. In some cases the demand for current has not been encouraging, but in others, especially that of the Metropolitan Electric Supply Company, the supply has barely kept pace with the demand. The London Electric Supply Corporation, which was by now to have had lights numbered by the hundred thousand in operation, is still dependent on the Grosvenor Gallery for the supply of its customers. Current at the pressure of 5,000 volts has indeed been transmitted from Deptford to the Grosvenor Gallery, and thence at a pressure of 2,400 volts to the consumers' houses, but this has only been done in an experimental fashion, and I have yet to hear that current at a pressure of 10,000 volts has been made to do so much as this. The reason alleged for this unfortunate delay, which has given rise to all manners of rumors, is that the disturbance in the iron market has retarded the construction of the Ferranti cable, the external casing of which is of solid steel. Although the total area allotted to the eight successful metropolitan companies amounts to something like 12 square miles, a large proportion of London, including the city, still remains untouched, and for this territory there are at present no less than 14 applicants. Turning from London to the provinces, the most noticeable feature of the year is the shower of electric lighting notices which fell upon the provincial authorities at the end of June, nearly 400 notices being served. The provincial authorities were at first all for doing the lighting themselves, but on making the by-no-means-surprising discovery that this proceeding would prove somewhat costly to the ratepayers, a greater disposition was shown to allow private companies to do the work themselves. However, of the 179 applications which were finally sent in to the Board of Trade at the end of November, nearly 30 per cent. were those of local authorities. Only a very small proportion of this 30 per cent. can, I am afraid, be deemed genuine, as most of the applicants are owners of gas works, and have more or less plainly announced their intention of preventing the electric light from injuring the ratepayers' gas works property. That slow-moving body, the City Commissioners of Sewers, after having had the question of the electric lighting of the city before them for over two years, have within the last few weeks brought themselves to perform the, to them, disagreeable task of allotting a portion of the city to an electric lighting company. Two-thirds of the city, however, still remains unallotted, but as five companies are now applying for Parliamentary powers, it may be anticipated that this tortuous policy of delay will not much longer retard the introduction of the electric light into the heart of the metropolis.

THE TELEGRAPH.

West Virginia.—A telegraph line is to be built from Grafton to Baltimore, under the superintendence of G. W. Warner, of Frederick, Md.

African Cables.—The cable from Mombasa to Zanzibar is now completed, and there is thus direct telegraphic communication between Europe and East Africa.

THE TELEPHONE.

New England Telephone.—At a meeting of the directors of the New England Telephone and Telegraph Company, held Jan. 22, a dividend of $1.25 per share was declared, payable on Saturday, Feb. 15, 1890, to stockholders of record at the close of business on Friday, Jan. 31, 1890. The transfer book will be closed on Feb. 1 to Feb. 14, 1890, both days included.

California Telephone Litigation.—Suit has been commenced in the United States Circuit Court of California by the American Bell Telephone Company of Massachusetts, the Pacific Telephone and Telegraph Company and the Sunset Telephone and Telegraph Company of California against Edward W. Fogg, John C. Gray, John R. Preston, Milton J. Green, Albert F. Jones, Edward A. Kusel, Carl E. Kusel and the Thermalito Improvement Company for infringement. All of the defendants are residents of Oroville, Cal.

THE ELECTRIC LIGHT.

Elizabethtown, Ky.—H. A. Sommers wants a small plant.

Vernon, Tex.—A local company has been formed, with R. S. Kelly as president.

Fort Worth, Tex., is to buy a plant, the cost not exceeding $27,000, which includes an engine of 160 h. p.

The Atchison (Kan.) Gas and Electric Light Company recently started a 125 h. p. Ball engine.

Louisville, Ky.—C. A. Curtin, architect, will purchase electric plant for the new $200,000 building of J. C. Lewis.

Lincolnton, N. C.—D. E. Rhynne & Co. are putting an electric light plant in their mill, to be driven by water power.

Marlin, Tex.—Thomas & Gorman, of Houston, Tex., will probably put in an electric light plant in connection with the new water works.

New Berne, N. C.—The New Berne Electric Light and Power Company has been incorporated by A. H. Leftwich, N. S. Mace and others with a capital stock of $75,000.

The Ball Engine Company, of Erie, Pa., has furnished a complete steam plant of 100 h. p. capacity to R. Mugge, of Tampa, Fla. The power is for a Heisler electric plant.

Columbus, Ga.—The Brush Electric Light and Power Company has received contract from the city for 76 arc lights, and has enlarged its plant to capacity for 100 arc and 1,000 incandescent lights.

The Central Thomson-Houston Company, of Cincinnati, are putting in a complete e ectrical plant for the DeCoppet Ice Company, of Somerset, Ky. The steam plant is furnished by the Ball Engine Company.

Troy, N. Y.—The Troy Electric Light Company has leased of the Edison Light and Power Company its plant at the northeast end of the depot for a term of fifty years. The company now furnishes 2,000 incandescent and 50 arc lights.

Halifax, N. S.—The name of the Chandler Electric Company, Limited, has been changed to the "Halifax Illuminating and Motor Company, Limited." The capital is to be increased from $100,000 to $500,000, in 50,000 shares of $10 each.

St. John, N. B.—The Carlton electric light station, on the western side of the St John (N. B.) harbor, and Salter's lumber mills, of which it formed a part, were burned last week. The plant was owned by D. W. Clark & Son, whose loss is $8,000.

Pomeroy, O.—The Pomeroy and Middleport Electric Company, Pomeroy, O., which began operations in October, has already placed its entire arc lighting capacity and contemplates adding an incandescent plant of some alternating system the coming season.

McMinnville, Tenn.—An electric light company has been organized, with W. P. Faulkner, president, and Jesse Walling, secretary. Power to operate the plant will be furnished by the Annis Cotton Mill Company, which will put in a new water wheel for that purpose.

San Francisco, Cal.—The *Pacific Lumberman* states that the California Electric Light Company, representing the Brush system in California, has established plants at seventeen other towns and cities, besides erecting some fifty private plants. It has nearly $1,000,000 invested in its own plant in San Francisco, and is furnishing nearly 2,000 arcs in the city. Arrangements are now being made

for the installation of 10,000 alternating incandescents. The company is doing a good motor business

An Interesting Point.—The Burlington Electric Light and Power Company, which has been in operation about three years, has filed a petition for an injunction to restrain the Burlington Gas Company from operating its electric light plant, started early this month, and to declare its lines a nuisance, and to have the poles removed; also to annul its franchise on the ground that the ordinance granting it had not been approved by a vote of the people. The last is the interesting point in the controversy, as no ordinance granting a franchise by a municipality in this State has ever been submitted to a vote of the people, and should the point be sustained it would operate to annul all franchises granted by municipalities to corporations in Iowa, that of the plantiff company included.

Thomson-Houston Output.—The appended summary gives the arc and incandescent light sales of the Thomson-Houston Electric Company in the last three years :

Lights.	1887.	1888.	1889.
Arc	17,949	19,436	24,031
Incandescent	73,635	122,385	294,760

With dynamo capacity sufficient to operate the same. The value of shipments from the Lynn factory in the quarter ended Dec. 31 last, was $2,700,000, and current shipments are from $35,000 to $40,000 per day. The total sales of all departments for the fiscal year to end with this month will vary but little from $8,000,000. The business of the railway department is growing enormously,

The Pennsylvania Railroad Company, having decided to increase the capacity of the electric lighting plant at their main offices in Fourth street, Philadelphia, have shifted their storage batteries to other commodious quarters in the forward part of the building, in order to utilize the old battery room in the rear for a Corliss engine, to be used as an auxiliary to their present power plant. The Electro Dynamic Company has been awarded the contract for making the necessary alterations in the battery plant, switches, wiring, etc. The system will be changed from 60 to 100 volts, the present capacity of the plant being about trebled. The original wiring by the Electro Dynamic Company for 1,200 lights is ample for the additional requirements.

Norwalk, Conn.—The annual meeting of the Norwalk & South Norwalk Electric Light Company was held at Norwalk, Conn., on Monday, Jan. 13. The year's business showed a most encouraging increase. The station has been very materially enlarged; a new 90 h. p. Ball engine with boilers has been installed; 1,300 Thomson-Houston incandescent, alternating current lamps have been added, together with a 50 light Schuyler arc dynamo. The plant was put in by the Schuyler Company in 1886, and since the day of starting has paid regularly a quarterly dividend of 2 per cent., and the stock is eagerly sought for. At the stockholders' meeting, the following directors were chosen: Chas. Olmstead, G. R. Cowles and John H. Hoyt, of Norwalk; Chas. E. Dustin, of Hartford, and Edward T. Jackson, of Middletown. The officers for the year are: Chas. Olmstead, of Norwalk, president; G. R. Cowles, Norwalk, vice-president: Chas. E. Dustin, treasurer, and John H. Hoyt, Norwalk, secretary.

APPLICATIONS OF POWER.

Richmond, Va.—The Southside Land and Improvement Company contemplate building an electric railway.

Nashville, Tenn.—The Citizens' Rapid Transit Railway Company will begin construction at once of a five-mile electric road.

Fort Worth, Tex.—It is reported that J. C. Avery, New York City, S. B. Carter, Newburyport, Mass., and others, who have purchased land, contemplate the construction of an electric motor line.

Fort Scott Electric Railway.—A syndicate of Davenport, Ia., capitalists have purchased the entire street-railway system of Fort Scott, Kan. Ten miles of electric road are to be built at once.

The Brooklyn Street Railway Company, of Cleveland, O., has just installed two 125 h. p. engines, making fourteen engines of this size now in their two power stations in the last eight months. The engines are the well-known "Ball," built by the Ball Engine Company, of Erie, Pa.

Col. I. C. Love claims, that there is $21,000,000 ready to construct an elevated electric road connecting East Liberty with Pittsburgh. So!

Piqua, O.—A Sprague electric railway has just been completed in Piqua by the Electrical Equipment Company of Chicago. This road is four miles long and employs four motor cars, each of the latest design, and operated by two 15 h. p. motors. The officers of the road are: President, A. M. Orr; vice-president, D. Spencer; treasurer, L. M. Flesh; secretary, Frank Davies.

British Columbia.—The Thomson-Houston electric railway system is now being adopted at Victoria, Vancouver's Island, and another road is being built at Vancouver, the terminus of the Canadian Pacific Railroad, supplemented by a plant of 300 arcs The points are over 80 miles apart and more than 4,000 miles from the base of supplies. The entire work has been placed in charge of Mr. I. Everson Winslow, of the company's engineering staff.

PERSONALS.

Prof. A. G. Bell has been traveling in the West, inquring into the condition of deaf mutes.

Mr. John O'Sullivan, an old time telegrapher, and formerly an operator in the Southwestern Army, died at Norfolk, Neb., on the 14th inst.

Col. W. A. Roebling, the Trenton, N. J., wire maker, recently gave to his wife, as a silver-wedding present, a $20,000 table service of gold and silver.

Mr. R. B. Owens, recently at Johns Hopkins University and the Baxter Motor Company, has accepted a position with the Excelsior Electric Company at their Brooklyn factory.

Mr. J. M. Stevens, manager of the Western Union Telegraph offices at Atlanta, Ga , has greatly improved his quarters and increased his staff, changes being made necessary by the increase in business.

Mr. Geo. H. Hartwell, the well-known lecturer on electricity and its applications, of Boston, has taken up permanent residence in this city. Mr. Hartwell proposes henceforth to devote himself entirely to electrical literary pursuits.

Dr. T. C. Mendenhall, Superintendent of the United States Coast and Geodetic Survey, delivered a lecture before the Engineers' Club of St. Louis, on the 10th ult., on the subject of "Standard Weights and Measures." Though the meeting was a special one, it was very largely attended.

Mr. Samuel Insull, of the Edison General Electric Company, whose overwork in connection with the business management of some half-dozen Edison manufacturing enterprises resulted in a very serious illness, left on Jan. 22 by the "Britannic" for England. He is now fairly convalescent, and hopes by travel and recreation for five or six weeks to return fully restored in health.

MISCELLANEOUS NOTES.

The Central Electric Company, of 116 and 118 Franklin street, Chicago, have sent us a handsome calendar, the top of which is skillfully made to illustrate the various applications of electricity and the various lines of supplies. At the top is the Okonite trademark, which now crops up everywhere, and to an electrical man seems as universal and all-pervading as "Sapolio."

The 1889 Prizes of the Academie des Sciences.—At the annual meeting of the Académie des Sciences on Dec. 30, it was announced that the La Caze prize had been awarded Dr. Hertz for his discovery of electric undulations, and of the curious effect of the ultra-violet rays on the electric charge. The Montyon prize for physiological researches was awarded to M. d'Arsonval, mainly on account of his electro-physiological work.

A High Order of Genius.—In discussing the evolution of the modern electric motor, the *London Times* says: "At the present time the efficiency of conversion obtained closely approaches the theoretical limit, some motors returning from 85 to 94 per cent. of the electrical energy supplied. This rapid progress is certainly due to the high order of genious brought to bear upon the matter by men of science, and to the mechanical ability of engineers, rather than to the simplicity of the subject."

New System of Electric Signals.—A special dispatch of Jan. 15 from Washington says: "J. R. Branch, of the Universal Electric Railway Signal Company, gave an exhibition this afternoon of the company's new invention of electric train signaling. The idea is to enable the engineers of locomotives to communicate with each other by telephone or a code of signals at any point along the road when they come within a specified distance of each other—running either in the same or opposite directions."

BUSINESS NOTICES.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas lighting batteries if accidentally grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company, of Syracuse, N. Y., No. 105 South Warren street.

Leather Link Belting.—

They never slip and they never burn,
The only belt for "quarter turn."
On dynamos these belts work "bully,"
They hug and stick fast to the pulley;
They hold up each and every light,
And everything goes on all right.
So save your time and save your pelt,
And buy an American leather-link belt. —H. B.

The Eclipse Wind Engine Company, Beloit, Wis., closed up the business of 1889 well satisfied with the patronage it has received. It begins the new year loaded up with orders for the equipment of numerous plants with friction clutch pulleys, couplings, shafting, stands, friction rope sheaves, etc., etc. Some of the notably large orders are from the La Clede Gas Light Company, St. Louis; Union Depot Railroad Company, St. Louis; the Detroit Electric Light and Power Company; the New Omaha Thomson-Houston Electric and Power Company, and from the Cincinnati Electric Light and Power Company. These, with others of minor note, keep the works humming night and day.

The Page Belting Company, of Concord, N. H., with branches located at Boston, New York, Chicago and San Francisco reports a very large increase of business during the past year, aggregating in value of goods more than 35 per cent. over 1888, which fact would appear to be good proof of the quality of the goods manufactured by that house and the good name which it has sustained now for over twenty years of continuous and successful business. Their Chicago branch has been converted into a store of their own, under the management of F. F. Wormer. By this change an improved arrangement for reaching business in the West and Northwest is accomplished and even a much larger trade than in the past is assured. Their store is located at 165 Lake street, where a full line of their staples and specialties is carried in stock. This line of specialties includes their patented "link belt, known as the "Acme."

Houston's Electrical Dictionary is in receipt of favorable reviews and notices everywhere. One of the latest comes from the San Francisco *Argonaut*, which says:

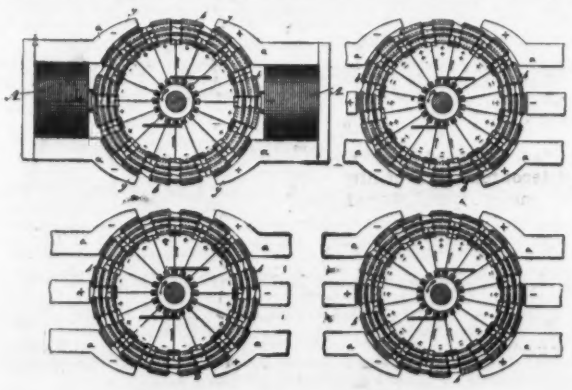
"The rapid growth of electrical science and its intimacy with the affairs of every-day life have made a dictionary of electrical terms a necessity, and to fill this want "A Dictionary of Electrical Words, Terms, and Phrases" has been prepared by Edwin J. Houston, a well-known scientist. The work is a popular one, bringing together the technical words which have been coming to life of late in the electrical journals and many of which have not yet found their way into the dictionaries; these are here defined in exact phrases, but so clearly stated that, with the aid of the many illustrative cuts, they are clearly intelligible to the lay reader. The book is of handy size and shape, contains more than six hundred and fifty pages, and is well printed."

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS ISSUED JANUARY 14, 1890.

419,245. Electric Motor; Stanley C. C. Currie, of Philadelphia, Pa., Assignor to the United Electric Improvement Company, of Gloucester City, N. J Application filed July 25, 1889. The combination, with opposite sets of field magnet poles, each having a middle pole of given polarity and outside poles of opposite polarity, unlike poles in the two sets being opposite each other, of an interposed multipolar armature wound with independent circuits, each winding or circuit consisting of a series of coils wound alternately in reverse direction, and the commutator bars and brushes. See illustration.

419,264. Method of Making Electrolytic Meters; Arthur E. Kennelly, of Orange, Assignor to Thomas A. Edison, of Llewellyn Park, N. J. Application filed Feb. 25, 1889. The pro-

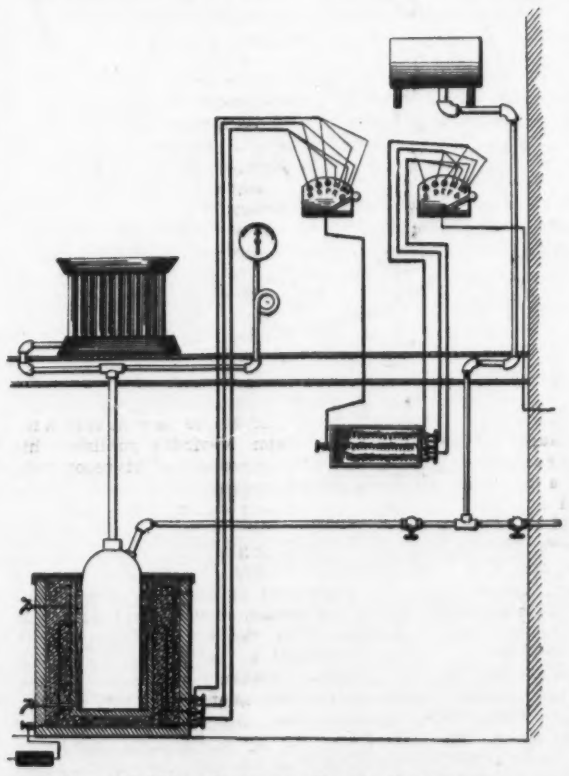


No. 419,245.—ELECTRIC MOTOR.

cess of making electrolytic meters, which consists in heating both the solution and the electrodes to expel the oxygen therefrom.

419,282. Electric Steam Generator; Jeremiah O'Meara, of New York, N. Y. Application filed April 2, 1889. The invention consists of a "crucible" of refractory material, which is rendered incandescent by means of an electric current, or by means of any other heat-producing agent, which preferably will not evolve smoke or other noxious products of combustion. This crucible contains a vessel for holding water which is to be heated or turned into steam or a heated slug. See illustration.

419,308. Conduit for Electric Railways; Bernard J. Black, of Richmond, Va., Assignor to himself, Wilton F. Jenkins, Erdmann Hoffman, Theodore Heinson, and Daniel Stephenson, all of the same place. Application filed May 3, 1889. A conduit for electric railways consisting of essentially U-shaped yoke-sections, one wall of the yokes extending upward above ground, forming

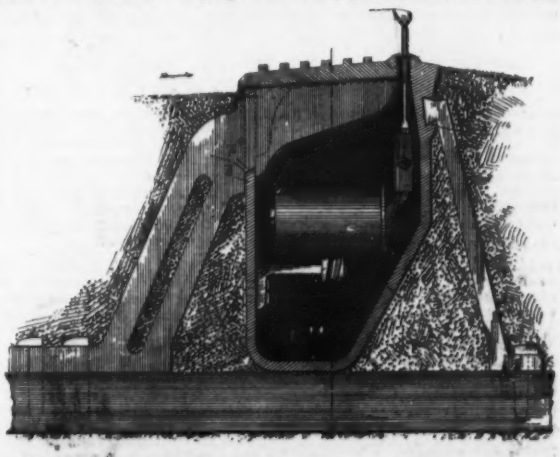


No. 419,282.—ELECTRIC STEAM GENERATOR.

one edge of the conduit slot, and detachable cover plates secured over the yoke sections, the inner edges thereof forming the opposite edge of the conduit slot. See illustation.

419,309. Electric Street Railway; Bernard J. Black and Wilton F. Jenkins, of Richmond, Va. Application filed May 25, 1889. The combination, with a car body and a depending bracket or keeper, having vertical play, secured thereto, of a trolley having a transverse head or bar detachably held within the keeper and having lateral play therein, the trolley adapted to be pulled away from its support by displacement of the car body.

419,312. Draft Annunciator for Mines; William Bulluck, of Centralia, Pa. Application filed June 18, 1889. In a draft annunciator the combination, with the fan wheel located in a mine airway, and adapted to be rotated by the air in the same, of an electric bell, a circuit breaker, means for operating the circuit breaker from the fan wheel, circuit wires, a spring governor operated by the fan wheel, and contacts with which the governor engages, whereby provision is made for sounding the bell at intervals, varying with the speed of the fan wheel, and



No. 419,308.—CONDUIT FOR ELECTRIC RAILWAYS.

also for sounding the bell continuously when the fan whee slackens below a certain speed.

(1) 419,313. Electric Railroad Telegraph. (2) 419,314. Electric Railroad; Baylus Cade, of Louisburg, N. C. Applications filed (1) May 11, 1889; (2) Aug. 9, 1889. (1) An electric railroad telegraph consisting of three conductors for sliding contact, one of which is made in sections which extend from station to station, and has in each section a battery with a normally open circuit and one pole grounded, and the other two of which conductors extend in alternating sections a distance of two stations, and are normally connected and provided with a main battery, in combination with sliding contacts and a telegraphic instrument on the car, and devices for opening and closing the main circuit at the stations by the action of the section batteries. (2) In an electric railroad, the combination, with a car having sliding contacts and an electric motor, of a series of conductors made of the

length of two sections and arranged parallel to, and alternately lapping past, each other, a circuit breaker for connecting the end of one conductor with the middle of the alternating conductor, and a local battery and conductor for each section, arranged to be closed by the car to open the circuit breaker of the section of the main current upon which the car is passing.

419,365. Electric Connector; John A. Seely, of Brooklyn, N. Y. Application filed Oct. 30, 1889. For description see page 73 this issue.

419,367. Meter for Alternating Currents; Oliver B. Shallenberger, of Rochester, N. Y., Assignor to the Westinghouse Electric Co., of Pittsburgh, Pa. Application filed October 31, 1888. In an electric meter having a rotating armature, an inducing conductor polarizing the armature when traversed by alternating electric currents, and a second inducing conductor receiving currents from the first and polarizing the armature in a different direction, and an adjustable support for one of the conductors, whereby it may be turned about the axis of the armature.

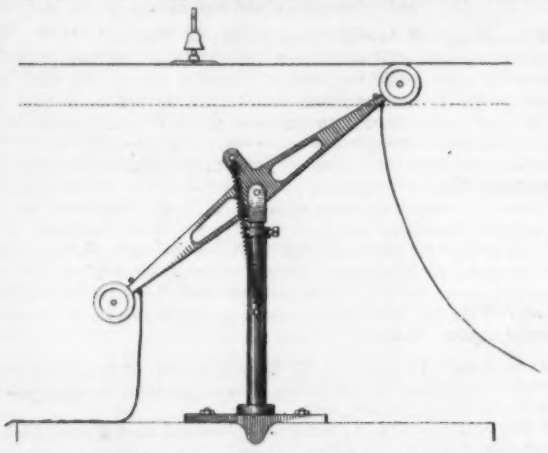
419,487. Electric Cut-Out; John F. Wollensak, of Chicago, Ill. Application filed Oct. 15, 1889. In an electric cut-out the combination of a bracket, an insulating piece arranged in the bracket, a binding screw arranged in the insulating piece and exposed in one portion, and a thumb screw that may be turned into the bracket until it connects with the exposed portion of the binding screw, and out until it disconnects therefrom.

419,588. Electric Railway; Isidor Kitsee, of Cincinnati, Ohio. Assignor to Mayer Sulzberger, trustee, of Philadelphia, Pa. Application filed Fed. 23, 1889. In an electric railway, an iron conductor or conductors in combination with magnetic contact devices, the magnetic contact devices being the terminals of the electric motor.

419,617. Socket for Incandescent Lamps; Charles H. Lawton, of New York, N. Y., Assignor to I. S. Elkins and J. S. Zerbe, of same place. Application filed Feb. 28, 1889. The combination, with an electric lamp globe, the insulating cap on the neck of the globe, and terminal blocks embedded in the base of the cap and uncovered at their inner sides of the divided socket shell, the switch bar sliding in the socket, and arms secured to, and standing from, the bar at such distances apart (the arms being connected directly to the circuit wires) that the bar can be slid in one direction to bring the arms in contact with the corresponding terminal blocks, and in the opposite direction to break the circuit.

PATENTS ISSUED JAN. 21, 1890.

419,618. Electric Railway System; Thomas Edgar Adams, of Cleveland, O. Application filed July 24, 1889. In an electric railway system, the combination, with two line conductors subdivided into sections or blocks, of switches arranged to support the conductors at the adjacent ends of the sections or blocks, the switches being each provided with a horizontally movable switch bar provided at its opposite ends with contacts, by means of which



No. 419,771.—Overhead Contact and Switch.

the circuit between the adjacent ends of one line conductor is opened and the circuit between the adjacent ends of the other line conductor is closed.

419,633. Galvanic Battery; William Burnley, of North East, Pa., Assignor of two-thirds to Charles A. Hitchcock, of same place, and Samuel A. Davenport, of Erie, Pa. Application filed May 25, 1889. The combination, in a galvanic battery, of a positive electrode and a negative electrode, with a semi-solid or plastic exciting agent arranged in two layers and filling the space between the positive and negative electrodes, the layer thereof next to and contacting with the negative electrode having depolarizing agents intermixed therewith, and the layer next to and contacting with the positive electrode not having any depolarizing agents intermixed therewith.

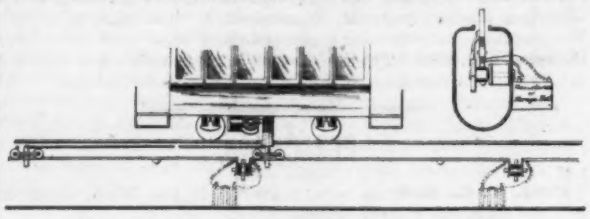
419,642. Insulator for Electric Wires; Isaac P. Cornog, of Philadelphia, Pa. Application filed July 8, 1889. The invention consists of a metallic clamping piece, which is secured to the supporting pole or other object from which the wires are to be suspended, and clamped between the jaws of which is a tubular piece of glass or other suitable insulating material provided with a central hole, through which the wire is inserted. This tubular piece is constructed in halves, and to insure the two pieces being firmly held together the abutting faces are each provided with a lug and a recess, the lug of one piece fitting into the recess of the other piece when the two are clamped together.

419,645. Telephonic Circuit and Apparatus; John N. Culbertson, of Buffalo, N. Y., Assignor to the American Bell Telephone Co., of Boston, Mass. Application filed May 28, 1889. A multiple-station metallic telephone and a signaling circuit comprising two main leads or wires extending from a central station to the several sub-stations provided at each sub-station with telephones included in a normally open multiple-arc branch, adapted, when closed, to unite the main leads and to form a metallic circuit including the telephones and a normally closed signaling extension conductor connected with one of the main wires at the sub-station nearest to the central station, extending therefrom serially through the signal-sending and receiving appliances of all the sub-stations to the most distant sub-station, and being there united with a return conductor. Thus when the line is at rest a calling circuit with the calling apparatus of the several stations in series is constituted, the telephones being disconnected, and when the line is in use for conversation a metallic circuit through the telephones of any desired station may be constituted, the signaling extension being disconnected.

(1) 419,660. Electric Commutator. (2) 419,661. Dynamo or Motor. (3) 419,662. Electric Commutator. (4) 419,663. Method of Producing Alternating Electric Currents. (5) 419,664. Alternating Electric Current Motor Regulator; Ludwig Gutmann, of Fort Wayne, Ind. Applications filed (1), (2) and (3) Sept. 18, 1888. (4) Nov. 17, 1888, and (5) Feb. 22, 1889. (1) A commutator whose contact plates are subdivided, and each plate consists of a low resistance conductor fixed between two conductors of high resistance. (2) In a dynamo, the combination of a stationary armature constructed in sections, each section consisting of pieces of iron provided with holes for the reception of retaining bolts, a second set of bolts passing between the pieces of iron and provided with projections which press against a flat coil of the armature, a coil passing back and forth across the inner surface of the armature and retained permanently against the surface, and a suitable field magnet, rotary and located so that its magnetic poles are adapted to just escape the coil. (3) The invention relates to a device for changing a continuous current such as is generated by a battery or direct current dynamo into an alternating current of a similar nature to that which is produced by an alternating current dynamo. (4) The method of producing an alternating electric current, which consists in generating a continuous electric current of a given normal strength, gradually diminishing the strength to zero, reversing the current, increasing the strength of the current from zero gradually to maximum or normal strength, gradually diminishing the strength from maximum to zero, again reversing the current, and so on in rapid succession. (5) In an alternating current motor the combination of an armature having an independent circuit, a subdivided field magnet wire, both the ends of each subdivision being open, and contact slides for coupling all or less of the subdivisions in multiple arc with one another to the work circuit.

419,673. Electrical Railway System; Thomas H. Hicks, of Detroit, Mich., Assignor, by direct and mesne assignments, to the Electrical Invention Company, of Michigan. Application filed March 6, 1889. In an electrical railway system, a main line, a source of electricity therefor, a car, a source of electricity thereon, a motor adapted to propel the car, a two-rail track electrically divided into sections, an electro magnet and armature for each section, a wire for each rail of each section, a contact for each wire normally out of contact with the same, but electrically connected with the main line and adapted to be automatically brought into contact with the rail wires and direct the current through the motor by way of the rail section on which the car is traveling by the electrical generator on the car closing a local circuit.

419,674. Shield or Protector for Electric Conductors of Combined Gas and Electric Fixtures; John C. Hollings, of Boston, Mass. Application filed Sept. 17, 1889. The invention consists in a swing joint and a fixture of pipes leading



No. 419,709.—Electric Railway System.

thereto, each pipe having an opening at or near the swing joint, and an electrical conductor leading from one of the pipes outside the swing joint and into the other of the pipes, combined with a shield applied to the swing pipe to cover and conceal the electric conductor.

419,709. Electric Railway System; Charles Richter, of Camden, N. J. Application filed May 4, 1889. An electric railway system composed of a conducting wire divided into sections, a station-resistance at the end of each section, a switch between the sections, a car having a contact roller, an electro-motor on the car, a contact wagon at some distance from the car, a conducting cable connecting the electro-motor with the contact wagon, and devices, respectively, on the car and contact wagon truck for opening and closing the switches.

419,710. Electric Protective System; Arthur C. Robbins, of Brooklyn, N. Y. Application filed Aug. 1, 1889. The system consists of an exterior circuit equipped with resistances, thermostats, or any other transmitting apparatus at the location to be protected, in connection with an interior or central office circuit which is a fac simile, so far as the arrangement and value of the resistances are concerned, of the external circuit. There is located at the central office a single alarm apparatus, which is operated whenever a disturbance occurs on the external circuit to notify the attendant of the fact.

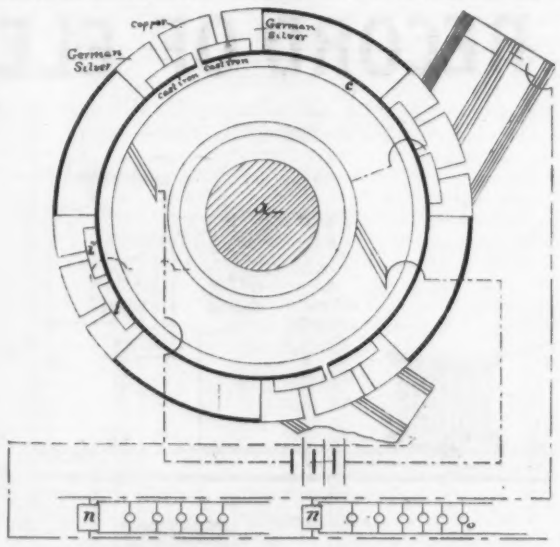
419,727. Method of Treating Secondary Battery Plates; Charles Sorley, of New York, N. Y., Assignor to the Anglo-American Electric Light Manufacturing Company, of West Virginia. Application filed Nov. 12, 1889. The method of treating storage battery plates, which consists in first packing a grid, support or electrode with active material in a dry, pulverulent state, and then gradually and slowly immersing the plate in an electrolyte.

419,728. Electrode for Secondary Batteries; Charles Sorley, of New York, N. Y., Assignor to the Anglo-American Electric Light Manufacturing Company, of West Virginia. Application filed Nov. 12, 1889. The invention consists in a storage battery electrode, plate, grid or support of any suitable material containing massicot as the active material.

(1) 419,730. Galvanic Battery. (2) 419,731. Portable Faradic Battery; Lucius T. Stanley, of Brooklyn, N. Y., Assignor to the Stanley Electric Company, of Philadelphia, Pa. Application filed Jan. 12, 1889. Renewed Nov. 16, 1889. The invention consists in a battery, one of the electrodes of which is a carbon cell provided with an annular cover, into which an insulating plug carrying the zinc electrode is inserted. (2) A case for portable Faradic batteries, consisting of a central metallic portion forming one of the electrodes, insulating ends, one containing the battery, the other provided with a metallic terminal, and a switch for connecting the metallic terminal with the central part constituting the electrode.

419,733. Cut-Out; Charles B. Story, of Brunswick, Me., Application filed April 9, 1889. The invention consists in the combination with the hollow base provided on its inner side with contact arms having stems extended through the base and to which the line wires are connected, of a plug provided with contact arms on its periphery to co-operate with the contact arms on the base and form a sliding contact therewith, and a fusible connection between the contact arms.

419,740. Electro-Thermal Current Regulator; Frank C. Wagner, of Ann Arbor, Mich. Application filed Sept 28, 1889. In an electro-thermal current regulator, the combination of a stretched metal strip, a support therefor having sensibly the



No. 419,663.—Method of Producing Alternating Electric Currents.

same coefficient of expansion, a continuously variable resistance device and mechanical connections, such that the transverse movement of the stretched metal strip operates the resistance device

419,753. Electric Locomotive; William H. Darling, of New York, N. Y., Assignor of two-thirds to Leo Bock, Jr., and Gardner P. Harrington, both of same place. Application filed March 23, 1889. In an electric locomotive, the combination, with a hollow saddle, of an electric cylinder carried in a casing bolted to and communicating with the hollow saddle, an air-outlet, leading from the hollow saddle, and the air-apertures in the cylinder heads.

419,766. Electric Door Opener. Ado Glaeser, of Brooklyn, N. Y. Application filed Dec. 27, 1888. The invention consists of an electric door opener set into a recess of the fixed door section or door casing and worked in connection with the spring bolt of the lock and a spring pusher, the door opener being provided with an oscillating and spring actuated latch that is released when the armature is attracted by vitalizing an electro-magnet of the door opener. A locking lever frame having an anti-friction roller holds the latch in normally closed position and is operated by pivoted spring levers which abut against the armature when the same is not attracted by the electro-magnet. When the armature is attracted, the spring levers and lever frame release the latch and permit the oscillating of the latter out of the path of the spring bolt of the door, so that the latter can be opened.

419,771. Overhead Contact and Switch; Robert W. Hawkesworth, of East Orange, N. J. Application filed Oct. 14, 1889. A trolley for electric railroads, consisting of a pivoted double-ended arm carrying contact devices at each end, and means for maintaining either end in contact with the conductor. See illustration.

419,774. Galvanic Battery; William E. Irish, of Cleveland, Ohio, Assignor to the Irish Electric Company, of same place. Application filed July 18, 1889. In a voltaic battery cell, in combination, a positive electrode immersed in a solution of sulphuric acid, mecca oil, and a sulphate of an alkaline metal, and a negative electrode immersed in a solution of bichromate of potash, chlorate of potash, nitrate of soda, flour of sulphur, nitric acid, sulphuric acid, and chromic acid.

419,776. Electrical Clock; Ansel B. Jones, of Cleveland, Ohio. Application filed Jan. 17, 1887. In an electric clock, the combination, with the escapement thereof and a pendulum, of the pawl, lever, armature, armature supporting pins, inserted in the magnet heads, spring, and a circuit changer adapted for a closed circuit.

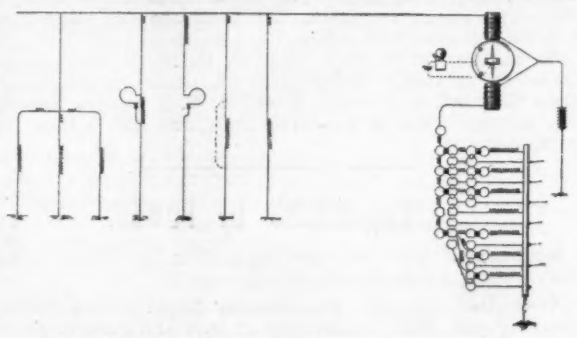
419,808. Electric Motor; Le Roy S. White, of Waterbury, Conn. Application filed Nov. 13, 1888. In a motor, the combination with a number of field bobbins and an armature, of a commutator composed of a multiplicity of separate strips, certain of the strips being connected together electrically to form sets, each of the sets being connected electrically with one of the field bobbins and a rotary brush provided with a number of contact points contacting with the ends of the strips and adapted to successively bring the sets of commutator strips into circuit and to successively energize the field bobbins.

419,829. Electric Lamp; Sam B. Cobb, of Chicago, Ill. Application filed March 10, 1888. An incandescent electric lamp, comprising the usual bulb, carbon and conducting wires, and provided on the exterior of the bulb with a non-conducting liquid contained in a single chamber and surrounding both the wires.

419,841. Electric Railway; Mark W. Dewey, of Syracuse, N. Y., Assignor to the Dewey Corporation, of same place. Application filed Nov. 2, 1889. For description, see page 74 this issue.

419,861. Electric Reciprocating Tool; Harry N. Marvin, of Syracuse, N. Y. Application filed April 29, 1889. A source of electric currents, consisting of a field magnet and an armature revolving in the field of the magnet, carrying a continuous sectional coil of wire, a commutator consisting of insulated sections connected to the respective sections of the armature coil, two contact brushes making contact with the commutator, a collector in connection with one section of the armature coil, two contact brushes making contact with the commutator, a collector in connection with one section of the armature coil, a brush at all times in connection with the collector, a second collector in connection with the diametrically opposite section of the armature coil, and two contact brushes alternately making contact with the second collector, each of the brushes connected to an independent circuit.

419,862. Secondary Battery; Jacob F. Mehren, of Chicago, Ill. Application filed March 12, 1889. A perforated plate for electric batteries, having its perforations flaring in one and the same



No. 419,710.—Electric Protective System.

direction toward one surface of the plate, and provided between perforations on the side toward which they taper with ridges or stops.

419,902. Automatic Fire-Alarm; Eugen Wider, of Stuttgart, Wurtemberg, Ger. Application filed July 10, 1889. The invention consists of an apparatus operated at the outbreak of a fire, by means of one or more fuses, so as to effect a strong detonation and to operate, by the closing of an electric circuit, one or more electric gongs or bells in suitable localities.

419,923. Electrical Conductor; Hiram H. Carpenter, of New York, N. Y. Application filed Dec. 5, 1889. The combination of the traction rail, with an independent detachable cover, supported by and fastened to the rail, and the electric wires within the cover.

419,962. Insulating Pipe-Joint; George M. Lane, of Asbury Park, N. J. Application filed March 16, 1889. An insulating joint or coupling for pipes, comprising an insulating tubular section and inner and outer metal thimbles secured to the ends of the section, one of the thimbles being threaded and adapted to receive the ends of the pipe to be coupled.

419,986. Mechanical Telephone; Robert C. M. Bowles, of Boston, Mass. Application filed Sept. 15, 1888. Renewed Dec. 26, 1889. The invention consists in suspending or holding the telephone upon the line wire itself, and then providing means for holding the diaphragm of the telephone under a tension equal to or proportionate to that of the line wire; and further in providing means for adjusting the tension of the diaphragm.

PATENTS EXPIRED JAN. 7, 1889.

134,552. Improvement in Fire-Alarm Signal Boxes; Finley Latta, of Cincinnati, Ohio. This signal bar is rigidly attached to a piston or plunger which plays snugly within a cylinder that depends from the bottom of the signal box proper, and the piston is capable of being elevated within the cylinder and allowed to descend therein.

134,636. Improvement in Apparatus for Electric Measurement; Leverett Bradley, of Jersey City, N. J. The galvanometer needle is composed of a single circular plate.

PATENTS EXPIRED JAN. 14, 1890.

134,776. Improvement in Repeaters for Duplex Telegraphs; Joseph B. Stearns, of Boston, Mass. Consists in a form, which repeats simultaneously to each station signals arriving from opposite stations on the same line wire at the same time.

134,866. Improvement in Printing Telegraph Instruments; Thomas A. Edison, of Newark, N. J. A type wheel magnet in the circuit that is opened and closed by the pulsator, in combination with a stop that arrests the movement of the pulsator when the circuit is broken, and a spring or its equivalent, that liberates the pulsator upon completing the backward movement of the armature and pallets.

134,867. Automatic Telegraph Instruments; Thomas A. Edison, of Newark, N. J., Assignor to himself and George Harrington, of Washington, D. C. The circuit from the battery connected with the earth and line in a chemical telegraph instrument and adjusted by a rheostat to neutralize earth currents.

134,868. Improvement in Electro-Magnetic Adjusters; Thomas A. Edison, of Newark, N. J., Assignor to himself and George Harrington, of Washington, D. C. The adjustable connnection applied at the rear end of an electro-magnet, between the cores thereof, to vary the power of such electro-magnet.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co, Ltd., Times Building, N. Y.